ENVIRON

HUMAN HEALTH RISK ASSESMENT

Remedial Investigation/Feasibility Study
Eagle Zinc Company Site
Hillsboro, Illinois

Submitted to:

U.S. Environmental Protection Agency, Region 5
and
Illinois Environmental Protection Agency

Submitted by:

ENVIRON International Corporation
Deerfield, Illinois

On behalf of:

Eagle Zinc Parties

August 2004

ENVIRON

August 19, 2004

Mr. Dion Novak
Superfund Division
United States Environmental Protection Agency
77 West Jackson Boulevard
Mail Code: SR-6J
Chicago, IL 60604

Re: Human Health Risk Assessment
Remedial Investigation/Feasibility Study
Eagle Zinc Company Site, Hillsboro, Illinois

Dear Mr. Novak:

Enclosed please find the report entitled *Human Health Risk Assessment* for the Eagle Zinc Company Site and a compact disk containing the report.

If you have any questions concerning this submission, please do not hesitate to contact us.

Sincerely,

ENVIRON International Corporation

F. Ross Jones

F. Ross Jones, P.G.
Manager

FRJ:rms
R \Client Project Files\Eagle Zinc-Hillsboro_21-7400E\Risk Assessment\HHRA_2004\Final Draft HHRA_Aug 04\HHRA transm ltr_081904 doc

Enclosures

cc: Thomas Krueger, Esq. – USEPA Region 5
Rick Lanham – IEPA Bureau of Land
Chris English – CH2M Hill
John Ix, Esq. – Dechert
Lois Kimbol, Esq. – Dechert
Paul Harper – Eagle-Picher
Gordon Kuntz – Sherwin-Williams
Roy Ball – ENVIRON
Janet Kester – ENVIRON

HUMAN HEALTH RISK ASSESMENT

Remedial Investigation/Feasibility Study
Eagle Zinc Company Site
Hillsboro, Illinois

Submitted to:

U.S. Environmental Protection Agency, Region 5
and
Illinois Environmental Protection Agency

Submitted by:

ENVIRON International Corporation
Deerfield, Illinois

On behalf of
Eagle Zinc Parties

August 2004

CONTENTS

CONTENTS
(continued)

CONTENTS
(continued)

TABLES

CONTENTS
(continued)

TABLES

FIGURES

ATTACHMENTS

EXECUTIVE SUMMARY

The Eagle Zinc Company Site ("the Site") occupies approximately 132 acres situated on two parcels of land in a mixed commercial/industrial/residential area in the Township of Hillsboro, Montgomery County, Illinois. An estimated 10 to 15% of the Site is covered by approximately 23 buildings. Other Site features include railroad spurs, residual material stockpiles, several paved and unpaved roadways, a southwestern storm water retention pond, a pair of engineered storm water retention ponds located near the eastern Site property boundary, and a small pond located between two railroad spurs near the entrance to the plant. According to former Eagle Zinc Company personnel, this pond was likely manmade and used for storage of water for fire fighting or other purposes.

The Site was in continuous industrial use for 90 years (from 1912 until 2002); operations included zinc smelting, manufacture of sulfuric acid, and manufacture of zinc oxide and leaded zinc oxide. The northern portion of the Site was historically used for agricultural production, which ceased in the 1980s. It was initially listed on the Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) on June 1, 1981. A remedial investigation/feasibility study (RI/FS) is being performed for the Site in accordance with the December 31, 2001 Administrative Order on Consent between the Eagle Zinc Site Parties ("the Parties") and the United States Environmental Protection Agency (EPA). As stated in the RI/FS Work Plan (ENVIRON 2002b), the primary focus of the RI is to characterize the nature and extent of releases at the Site, to assess potential migration pathways by which the Site-related chemicals could impact humans or valued ecological receptors, and to evaluate potential risks to those receptors.

On behalf of the Parties, ENVIRON has conducted a screening-level (Tier 1) human health risk assessment (HHRA) to quantitatively evaluate potential current and future human health risks associated with Site-related chemicals under continued commercial/industrial land use conditions in accordance with applicable EPA guidance. This HHRA is based on the data presented in the Remedial Investigation Phase 1 and Phase 2 Technical Memoranda (ENVIRON 2003a&b).

The first step of the risk assessment process was to identify Site-related chemicals of potential concern (COPCs). Analytes identified as COPCs for the specified media are listed in Table ES-1. Representative concentrations of these COPCs in on- and off-Site media were conservatively estimated as the lower of the 95% upper confidence limit (UCL) of the mean of the data set and the maximum detected value (summarized in Table ES- 2).

The HHRA was designed to estimate potential exposures in a manner that is both applicable to the Site and consistently conservative, resulting in calculated Tier 1 screening levels for each individual exposure pathway that are much more likely to over- than underestimate potential toxic risk/hazard for the defined receptor populations. Based upon an analysis of potential exposure pathways whereby humans could potentially come into contact with Site-related chemicals of potential concern (summarized in Table ES- 3), the following exposure scenarios were evaluated:

- <u>On-Site Commercial/Industrial Worker</u> – Exposure pathways considered complete for this receptor include incidental ingestion of and dermal contact with surface soil, and inhalation of respirable dust particles.

- <u>On-Site Construction Worker</u> – Exposure pathways considered complete for this receptor include incidental ingestion of and dermal contact with surface and subsurface soil, dermal contact with ground water in excavations, and inhalation of respirable dust particles.

- <u>Trespasser</u> – Exposure pathways considered complete for this receptor include incidental ingestion of surface soil and sediment, dermal contact with surface soil, inhalation of respirable dust particles, and dermal contact with and incidental ingestion of surface water while swimming in the southwest pond.

- <u>Off-Site Resident</u> – Exposure pathways considered complete for residents involve domestic use of potable surface water from Lake Hillsboro (ingestion, dermal contact).

- <u>Off-Site Recreational Bather</u> – Exposure pathways considered complete for this receptor include incidental ingestion of and dermal contact with surface water, and incidental ingestion of sediment while swimming in Lake Hillsboro.

- <u>Off-Site Recreational Fisher</u> – The potentially complete exposure pathway for this receptor is ingestion of fish from Lake Hillsboro.

Tier 1 screening levels for carcinogenic and non-carcinogenic effects were calculated for each of the exposure pathways identified for each of these receptor populations using conservative default exposure parameter values and algorithms from EPA guidance and EPA-approved toxicity criteria. These screening levels were based on a target cancer risk of one in one-million (10^{-6}), and a target non-cancer hazard quotient of 1, respectively.

In the Tier 1 risk characterization, Tier 1 screening levels were compared with representative concentrations in corresponding media to calculate Tier 1 hazard quotients (T1HQs) for non-carcinogenic effects and Tier 1 cancer risks (T1CRs) for carcinogenic effects. To account for simultaneous exposure to multiple COPCs, the risks/hazards calculated for each individual compound and exposure route in a given exposure medium were summed to obtain a total exposure pathway risk (EPA Region 9 2002). The total risks/hazards in each potential exposure medium were then summed over all media to obtain a total cumulative risk/hazard estimate. Cumulative T1HQs for non-carcinogenic effects are referred to as Tier 1 level hazard indices (T1HI).

The results of the Tier 1 HHRA indicated that with one exception, all cumulative T1HI are below the target level of 1, indicating little, if any, potential for adverse non-cancer health effects associated with the Site. Two sediment samples collected immediately south and southwest of the Site boundary contained levels of lead in excess of the highly conservative screening level (400 mg/kg), which is based on daily exposure of a young child to soil rather than occasional contact with aquatic sediment. Because the area of affected sediment is very limited and the Tier 1 screening level is based on a much more intensive exposure regime than could occur by occasional contact with sediment, the fact that individual sample results exceed a residential screening level for lead does not necessarily indicate that there is an elevated risk associated with lead in sediment. However, the fact that lead levels are elevated in this area may warrant further evaluation in the ecological risk assessment for the Site (ENVIRON 2004).

The only T1CRs greater than the target level of 10^{-6} were (1) 4×10^{-6} computed for the On-Site Commercial/Industrial Worker, due entirely to potential exposure to arsenic in surface soil, and (2) 3×10^{-6} computed for the off-Site Resident due to potential exposure to trichloroethylene in potable water from Lake Hillsboro when the upper bound of the proposed draft slope factor range is used. The representative concentration of arsenic (7.9 mg/kg) is below the Illinois background level (11.3 mg/kg), and arsenic was not used as a raw material and was not a product of Site operations. The detection-level value used as the representative concentration of trichloroethylene in Lake Hillsboro was obtained from a sampling location close to the Site, and as such does not represent conditions in Lake Hillsboro. Further, as discussed in Section III, this water is seldom used for potable purposes. Thus, these slight exceedances of the lower bound of EPA's target cancer risk range are not interpreted as suggestive of an unacceptable risk to human health.

The majority of assumptions involved in developing Tier 1 screening levels and representative concentrations are deliberately conservative, tending to overestimate exposure. As a result, the cumulative T1CRs/T1HI for the defined receptor populations

Table C-4. 95% Upper Confidence Limits for Groundwater (ug/L)

Analyte	CAS	# Samples	# Hits	Detection Limit		Reporting Limit		Detected Concentrations			# in Mean	Mean	Distribution	UCL		
				Min	Max	Min	Max	Min	Max	Location				Normal	Lognormal	Neither
Aluminum	7429-90-5	18	16	2.70E+01	2.70E+01	2.70E+01	2.90E+01	3.30E+01	1.10E+05	G109-030318	18	1.54E+04	Lognormal	2.82E+04	4.23E+04	2.82E+04
Arsenic	07440-38-2	18	4	8.10E+00	8.10E+00	8.10E+00	8.10E+00	1.70E+01	7.50E+01	G109-030318	18	1.71E+01	Neither	2.54E+01	2.24E+01	2.54E+01
Cadmium	7440-43-9	18	7	5.30E-01	5.30E-01	5.30E-01	5.30E-01	7.30E-01	3.90E+02	MW7-030318	18	3.68E+01	Neither	7.47E+01	6.51E+01	7.48E+01
Cadmium - Dissolved	7440-43-9	18	7	5.30E-01	5.30E-01	5.30E-01	5.30E-01	7.10E-01	3.30E+02	MW7-030318	18	2.68E+01	Neither	5.88E+01	2.91E+01	5.89E+01
Chromium	7440-47-3	18	8	9.30E-01	9.30E-01	9.30E-01	9.30E-01	1.20E+00	1.70E+02	G109-030318	18	2.87E+01	Neither	5.17E+01	4.24E+01	5.18E+01
Iron	7439-89-6	18	18			1.90E+01	1.90E+01	4.00E+01	2.10E+05	G109-030318	18	2.89E+04	Lognormal	5.33E+04	7.87E+04	5.34E+04
Lead	7439-92-1	18	8	1.30E+00	1.30E+00	1.30E+00	1.30E+00	3.40E+00	9.30E+02	MW4-030318	18	8.09E+01	Neither	1.70E+02	1.49E+02	1.70E+02
Lead - Dissolved	7439-92-1	18	3	1.30E+00	1.30E+00	1.30E+00	1.30E+00	1.50E+00	1.80E+01	MW8-030319	18	2.54E+00	Neither	4.21E+00	3.12E+00	4.21E+00
Manganese	7439-96-5	18	18			3.20E-01	3.20E-01	4.40E+00	1.20E+04	MW7-030318	18	1.68E+03	Lognormal	2.99E+03	5.04E+03	3.00E+03
Manganese - Dissolved	7439-96-5	18	18			3.20E-01	3.20E-01	1.40E+00	1.30E+04	MW7-030318	18	9.81E+02	Lognormal	2.22E+03	2.20E+03	2.22E+03
Thallium	7440-28-0	18	1	4.30E+00	4.30E+00	4.30E+00	4.30E+00		4.30E+00	MW1-030319	18	4.30E+00	Neither	4.30E+00		
Thallium - Dissolved	7440-28-0	18	1	4.30E+00	4.30E+00	4.30E+00	4.30E+00		7.40E+00	MW7-030318	18	4.47E+00	Neither	4.77E+00	4.75E+00	4.77E+00
Vanadium	7440-62-2	18	13	8.40E-01	8.40E-01	8.40E-01	8.40E-01	8.60E-01	2.00E+02	G109-030318	18	3.42E+01	Neither	6.16E+01	5.30E+01	6.17E+01
Zinc	7440-66-6	18	18			2.50E+00	1.20E+02	3.50E+00	2.10E+05	MW4-030318	18	2.10E+04	Lognormal	4.35E+04	9.67E+04	4.35E+04
Zinc - Dissolved	7440-66-6	18	18			2.50E+00	2.50E+01	5.00E+00	1.20E+05	MW7-030318	18	9.21E+03	Lognormal	2.07E+04	4.27E+04	2.07E+04

at the Site are likely to overstate potential risks/hazards. Because none of the cumulative T1CRs/T1HI exceeded target levels for either carcinogenic or non-carcinogenic effects (except for soil-associated arsenic, which is not Site-related), the available data support the conclusion that under current and reasonably anticipated future conditions, COPCs associated with the Site pose no significant cancer risk or non-carcinogenic hazard to the receptor populations considered in the HHRA. This conclusion comports with that reached by the Illinois Department of Public Health (IDPH) in its recent health consultation for this Site (IDPH 2002; included herein as Attachment A).

Table ES-1. Summary of Chemicals of Potential Concern in On- and Off-Site Media

Soil	Sediment	Ground Water	Surface Water
Arsenic	Arsenic	Sulfate	Cadmium
Cadmium	Cadmium	Aluminum	Iron
Iron	Iron	Arsenic	Zinc
Manganese	Lead	Cadmium	Trichloroethylene
Vanadium	Vanadium	Chromium[b]	
Zinc[a]	Zinc[a]	Iron	
	Trichloroethylene	Lead	
		Manganese	
		Thallium	
		Vanadium	
		Zinc	

[a] – Zinc could be eliminated as a COPC in this medium based upon the screening process, but was retained because it is a primary component of Site residues.
[b] -- Total chromium is conservatively assumed to be hexavalent.

Table ES- 2. Summary of Representative Concentrations of Chemicals of Potential Concern in On- and Off-Site Media

COPC	*On-Site*				*Off-Site*[a]		
	Soil (mg/kg)	Sediment (mg/kg)	Surface Water (mg/L)	Ground Water (mg/L)	Sediment (mg/kg)	Surface Water (mg/L)	Fish Tissue[b] (mg/kg)
Aluminum	NC	NC	NC	42.3	NC	NC	NC
Arsenic	7.93	25	NC	0.025	3.2[c]	NC	NC
Cadmium	31.9	550	0.23	0.075	8.9[c]	0.00053[c]	0.0265
Chromium	NC	NC	NC	0.052	NC	NC	NC
Iron	25,000	45,000	15	78.7	8,500[c]	0.23[c]	0.23
Lead	NC	2,700	NC	0.2	87[c]	NC	NC
Manganese	506	NC	NC	5.0	NC	NC	NC
Thallium	NC	NC	NC	0.005	NC	NC	NC
Vanadium	50.6	34	NC	0.0062	15[c]	NC	NC
Zinc	3,010	23,000	26	96.7	8,400[c]	0.84[c]	840
Trichloroethylene	NC	13	0.0063	NC	0.0012[c]	0.00039[c]	0.0066

NC = Not a COPC in medium

[a] Representative concentrations in sediment and surface water are from samples SD-ED-16 and SW-ED-16, respectively (nearest to Lake Hillsboro).

[b] Fish tissue concentrations estimated as product of representative concentration in off-Site surface water and chemical-specific bioconcentration factor

[c] Representative concentrations do not exceed respective COPC screening criteria in sediment and surface water (Tables 4 and 6, respectively). Nonetheless, they are used to conservatively estimate exposure and risk/hazard to receptors in Lake Hillsboro.

Table ES- 3. Summary of Potentially Complete Exposure Pathways To Be Considered in the HHRA for the Eagle Zinc Company Site

Receptor Scenario	Potential Exposure Medium	Potential Exposure Route	Pathway Considered Complete?	Rationale/Comment
On-Site Resident	Ground Water	Potable use	No	Historical use and zoning of the Site is industrial, and plans exist for future commercial/industrial re-use Therefore, residential development is not a reasonably anticipated future land use
On-Site Resident	Surface soil Subsurface soil	Vapor inhalation Particle inhalation Ingestion Dermal contact	No	Historical use and zoning of the Site is industrial, and plans exist for future commercial/industrial re-use Therefore, residential development is not a reasonably anticipated future land use
On-Site Industrial Worker	Ground Water	Potable use	No	Site ground water is not a current or potential source of potable water Potable water in these areas is supplied by the city Further, the low yield of the affected aquifer makes its development as a water source unlikely
On-Site Industrial Worker	Surface soil	Vapor inhalation Particle inhalation Ingestion Dermal contact	Yes	Workers could come into contact with surface soil Accordingly, exposure via ingestion, inhalation, and dermal contact will be evaluated
On-Site Industrial Worker	Subsurface soil	Vapor inhalation Particle inhalation Ingestion Dermal contact	Yes	Although workers would not contact subsurface soil under current conditions, it is possible that they could contact excavated material in the future Because the representative concentrations of COPCs in on-Site soil include both surface and subsurface samples, potential contact with subsurface material is accounted for.
On-Site Construction Worker	Ground Water	Potable use	No	Site ground water is not a current or potential source of potable water Potable water in these areas is supplied by the city Further, the low yield of the affected aquifer makes its development as a water source unlikely.
On-Site Construction Worker	Ground Water	Dermal contact	Yes	Construction workers could contact ground water while excavating
On-Site Construction Worker	Surface soil Subsurface soil	Vapor inhalation Particle inhalation Ingestion Dermal contact	Yes	Construction workers could contact surface and subsurface soil during excavation and building activities Accordingly, exposure via ingestion, inhalation, and dermal contact will be evaluated
Trespasser	Ground Water	Potable use	No	Site ground water is not a current or potential source of potable water Potable water in these areas is supplied by the city Further, the low yield of the affected aquifer makes its development as a water source unlikely
Trespasser	Subsurface soil	Vapor inhalation Particle inhalation Ingestion Dermal contact	No	Trespassers would not contact subsurface soil under reasonably foreseeable conditions
Trespasser	Surface soil	Vapor inhalation Particle inhalation Ingestion Dermal contact	Yes	Trespassers could come into contact with surface soil. Accordingly, exposure via ingestion, inhalation, and dermal contact will be evaluated
Trespasser	Southwest pond surface water	Ingestion Dermal contact	Yes	Surface water runoff as well as site ground water could flow into the southwestern pond, which could attract trespassers Therefore, swimming contact with COPCs in surface water and sediment will be considered in the risk assessment
Trespasser	Sediment	Ingestion	Yes	Surface water runoff as well as site ground water could flow into the southwestern pond, which could attract trespassers Therefore, swimming contact with COPCs in surface water and sediment will be considered in the risk assessment
Trespasser	Sediment	Dermal contact	No	Exposure to COPCs via dermal contact with sediment is considered to be negligible

Receptor Scenario	Potential Exposure Medium	Potential Exposure Route	Pathway Considered Complete?	Rationale/Comment
Off-Site Resident	Ground Water	Potable use	No	Site ground water is not a current or potential source of potable water Potable water in these areas is supplied by the city Further, the low yield of the affected aquifer makes its development as a water source unlikely
	Surface soil	Particle inhalation Ingestion Dermal contact	No	Soil investigations conducted by IEPA indicated no evidence of off-Site migration of affected surface soil Therefore, this potential exposure pathway is not complete.
	Lake Hillsboro surface water	Potable use	Yes	Lake Hillsboro is used as a backup drinking water source for the City of Hillsboro (primary source is Lake Glenn Shoals) Although the intake is distant from the point of confluence with water bodies affected by the Site, this potential pathway has been evaluated to ensure that drinking water quality is not impacted
Off-Site Recreational Bather	Lake Hillsboro surface water	Ingestion Dermal contact	Yes	Surface water runoff from the Site empties into an unnamed tributary of Mid Fork Shoal Creek to the southwest, and into an unnamed tributary to Lake Hillsboro to the east Recreational users wading and swimming in Lake Hillsboro could be exposed to chemicals present in surface water and sediment
	Lake Hillsboro sediment	Ingestion	Yes	
		Dermal contact	No	Exposure to COPCs via dermal contact with sediment is considered to be negligible
Off-Site Fisher	Fish in Lake Hillsboro	Ingestion	Yes	Regular consumption of fish from Lake Hillsboro is a possible exposure pathway

I. INTRODUCTION

The Eagle Zinc Company Site ("the Site") is located in the Township of Hillsboro, in central Montgomery County, Illinois (Figure 1). The Site was initially listed on the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) on June 1, 1981. A remedial investigation/feasibility study (RI/FS) is being performed for the Site in accordance with the December 31, 2001 Administrative Order on Consent between the Eagle Zinc Parties (the "Parties") and the United States Environmental Protection Agency (EPA).

A. Purpose

As stated in the RI/FS Work Plan (ENVIRON 2002b), the primary focus of the RI is to characterize the nature and extent of chemicals of potential concern (COPCs) at the Site, to assess potential migration pathways by which these chemicals could impact human or valued ecological receptors, and to evaluate potential risks to those receptors.

This document presents the human health risk assessment (HHRA) performed on behalf of the Parties to quantitatively evaluate potential current and future human health risks associated with the Site under continued commercial/industrial land use conditions. Specifically, the objectives of the assessment are to:

- Provide an analysis of potential receptor-specific risks, assuming no remedial action or institutional control;
- Provide a basis for estimating maximum acceptable concentrations of COPCs in Site media based on risk levels that adequately protect human health; and
- Determine which media may require remediation, institutional controls, or further evaluation.

B. Guidance Used

This HHRA was performed in accordance with applicable EPA guidance, including:

- *Risk Assessment Guidance for Superfund*, Volume I, Human Health Evaluation Manual, Part A (EPA 1989) ("RAGS");
- Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual, Part B (EPA 1991a);
- Soil Screening Guidance: Technical Background Document (EPA 1996);

- Supplemental Guidance to RAGS: Calculating the Concentration Term (EPA 1992);
- Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (EPA 2002c);
- Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part E (EPA 2001a);
- Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (EPA 2002a);
- *Exposure Factors Handbook* Volumes I through III (EPA 1997a, 1997b, 1997c); and
- Child-Specific Exposure Factors Handbook (EPA 2002b).

C. Components of Human Health Risk Assessment

The human health risk assessment process typically involves five basic elements:

- **Data Review and Evaluation:** Review of available data to (1) characterize the Site, (2) define the nature and magnitude of releases to environmental media (soil, air and water), and (3) identify COPCs (*i.e.*, chemicals that are associated with the Site and present in concentrations higher than background levels and conservative risk-based COPC screening levels), potentially complete exposure pathways, and human receptors (*i.e.*, people that could come in contact with COPCs).

- **Exposure Assessment:** Estimation of the amount, frequency, duration, and routes of receptor exposure to COPCs. The exposure assessment considers both current and likely future site uses, and is based on receptor scenarios that define the conditions of exposure to COPCs. The potential magnitude of exposure to defined receptors is determined by estimating the representative concentrations of COPCs available in environmental media at various portals of entry to the body (*i.e.*, the lungs, gastrointestinal tract, or skin). Exposure scenarios are summarized in the exposure pathway conceptual site model (CSM) for the Site (Figure 2).

- **Toxicity Assessment:** Review of available information to (1) identify the nature and degree of toxicity of each COPC, and (2) characterize the dose-response relationship (the relationship between magnitude of exposure and magnitude of adverse health effects) for each COPC. The EPA has developed chronic toxicity criteria for many chemicals for use in human health risk assessment. These values are not expected to result in adverse health effects even under lifelong exposure conditions. In addition, subchronic toxicity values are available for a smaller number of chemicals. These values are used to evaluate risk for scenarios with less-than-lifetime exposure (*e.g.*, construction workers).

- **Risk Characterization:** Synthesis of exposure and toxicity information to (1) determine the nature and magnitude of potential cancer risks and non-cancer hazards at a site, and (2) estimate what residual levels of chemicals do not pose unacceptable risks to potential receptors.

- **Uncertainty Analysis:** Qualitative and/or quantitative assessment of the sources, magnitude, and effects of uncertainty and variability in the exposure and toxicity parameter values, assumptions, and models used. An uncertainty analysis accounts for the variability in measured and estimated parameters, allowing decision-makers to better evaluate risk estimates in the context of the assumptions and data used in the assessment.

D. Tiered Approach to Human Health Risk Assessment at the Eagle Zinc Company Site

To ensure that protection of human health and the environment remains the focus of remedial activities at the Site, a two-tiered risk-based approach was used to (1) identify areas that may require further investigation, and (2) develop risk-based remedial target levels for affected media. This approach is depicted as a decision tree in Figure 3, and briefly described below.

1. Tier 1

In Tier 1, concentrations of COPCs at receptor exposure points are screened against chemical-, pathway-, and medium-specific criteria referred to as Tier 1 screening levels. Tier 1 screening levels are defined as concentrations of COPCs in relevant media that are not expected to produce any adverse health effects under chronic exposure conditions associated with all potentially complete exposure pathways identified in Table 1 and Figure 2. Tier 1 screening levels for carcinogenic and non-carcinogenic effects are based on a target cancer risk of 10^{-6}, and a target non-cancer hazard quotient of 1, respectively.

To ensure consistency, equations and parameter values from EPA guidance (EPA 1989, 1991a, 1992, 1996, 1997a-c, 2001, 2002a-c) are preferentially used to calculate Tier 1 screening levels for each potentially complete exposure pathway. For potentially complete exposure pathways not considered in EPA guidance, Tier 1 screening levels are based on conservative (upper-bound) exposure and modeling assumptions in order to ensure a similar degree of conservatism.

Because of the conservatism of Tier 1 screening levels, no further risk assessment will be performed for areas where cumulative Tier 1 hazards/risks are below acceptable target levels. For areas where target hazard/risk levels are exceeded, interim or final remedial action may be considered, or a Tier 2 assessment may be performed.

2. Tier 2

The distinction between generic screening levels and appropriate target levels for remediation is explicit in EPA guidance (*e.g.*, EPA, 1991a). Indeed, the guidance states that exceedance of generic screening levels does "not establish that cleanup to meet these goals is warranted." If Tier 1 screening levels are exceeded for any potentially complete exposure pathways, and interim or final remedial action is considered impracticable, then site-specific, health-protective Tier 2 remedial target levels may be calculated.

The equations used in Tier 2 follow the same general methodology used to generate Tier 1 screening levels, but actual site conditions, more sophisticated fate and transport models, COPC-specific chemical properties, and more realistic exposure assumptions will be incorporated as necessary and appropriate to develop Tier 2 remedial target levels. As in Tier 1, Tier 2 criteria are based on a target cancer risk level of 10^{-6} and a target non-cancer hazard quotient of 1.

No further risk assessment will be performed for areas where cumulative Tier 2 hazards/risks are below acceptable target levels. Where these levels are exceeded, interim or final remedial strategies may be considered.

E. Document Organization

The Tier 1 HHRA for the Site is organized into the following additional sections:

- *Section II, Data Review and Evaluation* provides a summary of the data collected at the Site, the selection process for identifying COPCs, the methodology used in the development of representative concentrations for the COPCs, and related uncertainties.

- *Section III, Exposure Assessment* describes the exposure pathway CSM and potential receptor scenarios representing relatively highly exposed populations that form the framework of the HHRA, identifies conservative exposure parameter values selected to represent a reasonable maximum estimate (RME) magnitude and frequency of contact via potentially complete exposure pathways, and describes uncertainties related to these elements.

- *Section IV, Toxicity Assessment* briefly describes the toxicity assessment process and lists toxicity and risk-based criteria for all COPCs in the HHRA and related uncertainties.

- *Section V, Development of Tier 1 Screening Levels* describes the methods and assumptions used in deriving Tier 1 screening levels for each of the receptor scenarios.

- *Section VI, Tier 1 Risk Characterization* compares representative concentrations of COPCs in potential exposure media with relevant Tier 1 screening levels for each receptor scenario to calculate Tier 1 cancer risks and non-cancer hazard indices.

- *Section VII, Summary and Conclusions* recapitulates the purpose, methods, results, and conclusions of the HHRA.

II. DATA REVIEW AND EVALUATION

A. Site Characterization

The following information is summarized from previously submitted ENVIRON documents (ENVIRON 2002a&b, 2003a&b).

1. Site Location and Description

The Site occupies approximately 132 acres situated on two parcels of land in a mixed commercial/industrial/residential area in the Township of Hillsboro, Montgomery County, Illinois (Figure 4). An estimated 10 to 15% of the Site is covered by approximately 23 buildings. Other Site features include railroad spurs, residual material stockpiles, several paved and unpaved roadways, a southwestern storm water retention pond, a pair of engineered storm water retention ponds located near the eastern Site property boundary, and a small pond located between two railroad spurs near the entrance to the plant. According to former Eagle Zinc Company personnel, this pond was likely manmade and used for storage of water for fire fighting or other purposes.

The Site extends from Smith Road south to an unnamed tributary to the Middle Fork of Shoal Creek. Industrial Drive extends north and south along much of the eastern property boundary. North of the Site is Smith Street, a small facility called Hayes Abrasives, a golf course, and farm fields. Industrial Drive, an asphalt company, a railroad corridor, and the former Hillsboro Glass Company facility (now a steel warehouse) are located east of the Site. Some small commercial/industrial facilities (University of Illinois Extension office, Fuller Brothers Construction/Ready Mix, Illinois Wood Preservers, Hillsboro Rental, Vogel Plumbing) are located south of the Site. Some undeveloped land and a residential area containing single- and multi-family dwellings are located west of the Site. The nearest residential properties are located approximately 200 feet west of the southern and central part of the Site's buffer zone.

2. Land Use

The Site was in continuous industrial use for 90 years (from 1912 until 2002); operations included zinc smelting, and manufacture of sulfuric acid, metallic zinc, zinc oxide and leaded zinc oxide. The northern portion of the site was historically used for agricultural production, which ceased in the 1980s.

According to the 2000 census, approximately 2,800 people live within a one-mile radius of the Site and approximately 9,300 people live within a five-mile radius of the Site. The Site property is zoned for commercial/industrial use, and local officials have indicated to ENVIRON that there are no plans to re-zone the property for other uses.

T.L. Diamond will record an enforceable deed restriction on the entire property that will run with the land and will limit future use of the property to industrial/commercial purposes. Documentation from the City of Hillsboro that it intends that the property will be used for industrial purposes as part of its overall comprehensive plan is provided as Attachment B. Therefore, this HHRA is based on the assumption that future land use at the Site will remain commercial/industrial, and does not include consideration of hypothetical future residential development.

B. Selection of Chemicals of Potential Concern for Risk Assessment

The first step of the risk assessment process is an evaluation of all available data to (1) characterize conditions at the Site, (2) develop a data set for use in the HHRA, and (3) identify COPCs. Previous documents have summarized site characterization information and described the data set (ENVIRON 2003a&b). COPCs are the focus of the risk assessment process. The following COPC selection criteria were applied to the risk assessment data set(s):

- Associated with former Site activities;
- Positively detected in more than 5% of samples;
- Positively detected in at least one sample at levels above Illinois background levels, if available; and
- Positively detected in at least one sample at levels above applicable COPC screening levels.

A decision tree depicting the selection process is shown in Figure 5.

Screening levels for selection of COPCs in soil and sediment are defined as the higher of Illinois background levels (if available) and EPA Region 3's Risk-Based Concentrations (RBCs) for the default residential exposure scenario (EPA Region 3 2003a). These values are considered a conservative tool for COPC screening because they are calculated using EPA RAGS methodology (*i.e.*, they are based on EPA-approved toxicity criteria and exposure rates that are not expected to cause cancer risk greater than 10^{-6}, or non-cancer hazard quotient greater than 1), are updated frequently (twice a year), and are consistently stringent. For example, RBCs are in most cases lower than corresponding Tier 1 remediation objectives developed under the Illinois Environmental Protection Agency's (IEPA's) "Tiered Approach to Corrective Action Objectives" (TACO).

Because the exposure rates expected for Site-specific non-residential exposure scenarios are substantially less than those assumed in the default residential scenario used in the calculation of the RBCs, chemicals at levels below the RBCs are not expected to contribute measurably to overall risk. In the case of potential carcinogens, use of a target risk level of 10^{-6} in the RBCs is expected to be protective of possible exposure to multiple carcinogenic COPCs based on EPA's acceptable cancer risk range of 10^{-6} to 10^{-4} (EPA 1991b). Because RBCs for non-carcinogenic chemicals were developed on the basis of childhood-only (*i.e.*, more intensive) exposures, their use in COPC screening is expected to be protective of cumulative hazards from exposures to multiple non-carcinogens in non-residential receptors. Thus, as recommended by EPA Region 3, it is appropriate to use these conservative screening levels to distinguish those COPCs that are significant contributors to potential risks from those that have minimal impact (EPA Region 3 1993).

For evaluation of samples taken in soil and sediment, the residential soil RBC was used as the COPC screening level. Since EPA Region 3 did not specify RBCs for lead, concentrations in surface and subsurface soil were compared to the action level of 400 mg/kg (EPA 2002a). As ground water is not used for drinking, and such use is not anticipated in the future because there is a public water supply (see Section III.D.2), no evaluation of the soil protective of ground water pathway was included in the HHRA. For screening of samples taken in surface water and ground water, tap water RBCs were used. In the absence of a Region 3 tap water RBC for lead, the maximum contaminant level (MCL) of 0.015 mg/L (EPA 2003c) was used for COPC screening. Because the majority of mercury in abiotic media is expected to be in the inorganic state, mercury was conservatively evaluated as mercuric chloride (corrosive sublimate). Although the majority of chromium in the environment is in the reduced (trivalent) state, chromium was conservatively assumed to be in the more toxic hexavalent state for purposes of screening.

Some of the compounds included in the EPA analytical methods have no associated EPA-approved toxicity values and hence lack Region 3 RBC values to which a comparison could be made. In such cases, either (1) a surrogate compound with approved toxicity criteria was selected, or (2) an RBC was calculated based upon toxicity factors located in the Texas Commission on Environmental Quality's document, Texas Risk Reduction Program (TCEQ 2003):

- Acenaphthene was selected as a surrogate for acenaphthylene; pyrene, for benzo(g,h,i)perylene and phenanthrene; xylenes, for *o*-xylene and *m+p*-xylenes; and 1,3-dichloropropene, for *cis*-1,3-dichloropropene and trans-1,3-dichloropropene.

- RBCs were calculated for 2-hexanone, 2-nitrophenol, 4-bromophenyl phenyl ether, 4-chloro-3-methylphenol, 4-chlorophenyl phenyl ether, 4-methyl-2-pentanone, 4-nitrophenol, *bis*(2-chloroethoxy)methane, chloromethane, cyclohexane, and methylcyclohexane.

To ensure that analytes are not spuriously screened out due to elevated detection limits, detection limits for analytes with no or few positive detections were also compared with COPC screening levels. If the maximum detection limit exceeded the COPC screening level in more than 5% of analyses, then the analyte was retained for qualitative consideration in the uncertainty analysis.

The Region 3 RBCs and Illinois background values used for COPC screening are listed in Table 2. Summaries of the COPC screening level selection process are presented in Tables 3, 4, 5, and 6 for soil, sediment, ground water, and surface water, respectively. Analytes identified as COPCs based upon this screening process are summarized in Table 7.

C. Calculation of Representative Concentrations

A representative concentration is defined as the concentration of a COPC in a given medium to which human receptors may be exposed. The representative concentration is subsequently compared with Tier 1 screening levels (Section V) to estimate Tier 1 cancer risk and non-cancer hazard (Section VI). Because of the uncertainties associated with any estimate of exposure concentrations, EPA has developed a conservative approach in which the lower of the 95% upper confidence limit (UCL) on the mean or the maximum compound concentration (detected concentration or reported detection limit) is used to determine the representative concentration for the media of interest. The 95% UCL was calculated in accordance with the methodology presented in *Supplemental Guidance to RAGS: Calculating the Concentration Term* (EPA 1992) and *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (EPA 2002c).

In the calculation of the 95% UCL, all non-detected results were assigned a proxy value equal to one-half the reported detection limit as is consistent with EPA (1989). For duplicate samples, if the compound was detected in both samples, then the average of the analytical values was used to represent the compound concentration in the evaluation. If the compound was detected in neither sample then one-half of the smallest reported detection limit was used as the representative concentration. If the compound was detected in one sample, but not detected in the other, the detected concentration was used as the representative concentration. The methods used are detailed in Attachment C.

The 95% UCLs were calculated as described above only for on-Site soil and ground water. As discussed in the Phase 1 Technical Memorandum (ENVIRON 2003a), available data and information concerning the residue piles do not suggest that air deposition has impacted off-Site areas. A detailed evaluation of all historical data for the Site, including the off-Site soil data collected by IEPA in 1993 as part of the CERCLA Expanded Site Inspection (ESI), indicated that no constituent concentrations detected in off-Site soils were determined to be significantly different from Site-specific background levels. While arsenic concentrations were determined to be different from the level detected in a local background sample, the highest detected concentration was only marginally above the average regional background level, as reflected by the non-Metropolitan Statistical Area (MSA) background value presented in the Illinois Tiered Approach to Corrective Action Objectives (TACO). In addition, arsenic is not known to have been used or released at the Site. As the off-Site soil samples collected by IEPA in 1993 were well-distributed around the Site, the available data do not indicate any detectable impacts to off-Site soils from constituents associated with the Site. The original Statement of Work for the RI/FS did not include off-Site soil sampling because the historical data did not suggest that this was a potential area of concern. Subsequent evaluation of possible migration pathways to off-Site soils documented in the technical memoranda (ENVIRON 2003a&b) also did not indicate a need for collection of off-Site soil data. Therefore, off-Site soil was not considered as a potential exposure medium in the HHRA.

To characterize constituent concentrations in on-Site soils, a specific number of borings (established in the SOW and RI/FS Work Plan) were completed at locations randomly selected from a 50 x 50-foot grid within each of seven areas of the Site (Areas 1-4, Manufacturing Area, Western Area, Northern Area). Because these areas do not represent actual or anticipated human activity patterns, receptor presence is considered equally likely in all areas, and sample locations were biased to locations exhibiting elevated XRF field screening levels, all available soil data were combined to calculate representative concentrations of soil COPCs for use in the HHRA. None of the borings were conducted through residue piles; however, some of the borings randomly fell within areas containing accumulations of surficial residues. Soils from each boring were screened for metals using XRF and organic vapors using a PID. The EPA-approved sampling methodology (also established in the SOW and RI/FS Work Plan) involved retaining samples for laboratory TAL Metals analysis from a specific number of borings exhibiting the highest metals concentrations determined using XRF. The soil samples for laboratory analysis were collected immediately below any surface residues present at the randomly selected location. Based on a lack of PID screening results above background levels, a subset of the TAL Metals samples was randomly selected for analysis of TCL Organics and PCBs. The locations of the soil borings, borings for which soils were retained for laboratory analysis, and concentrations detected above conservative screening levels used to evaluate the data are shown on Figure IV-1 of the March 2003 Phase 1 Technical Memorandum. Soil data and representative concentration calculations are presented in Attachment C.

Constituents present in groundwater were characterized from samples taken in March of 2003 in all newly installed permanent and temporary monitoring wells and all pre-existing wells, except for wells MW-A, MW-B, MW-D, MW-E, and G-108. All of the wells were sampled for TAL metals and sulfate. In addition, four of the ground water samples (MW1, MW4, MW8, and G107) were analyzed for TCL organic compounds and PCBs. The metals analyses were conducted using both field-filtered and unfiltered samples to determine dissolved and total metals concentrations, respectively. Groundwater data and representative concentration calculations are presented in Attachment C.

No determination of UCLs was performed for surface water and sediment locations since only data from the surface water and sediment sampling locations closest to Lake Hillsboro (SW-ED-16 and SD-ED-16, respectively) were used to characterize potential exposure of people using the Lake for drinking water, fishing, or recreational purposes. The maximum concentrations of COPCs in the surface water and sediment samples taken in the southwestern area of the Site (near the pond) were used as representative concentrations for Trespasser exposure. The values, UCLs or maximum detected concentrations, used as representative concentrations in potential exposure media are presented in Table 8.

D. Uncertainties Related to Data Review and Evaluation

1. Uncertainty Related to the Selection of Representative Concentrations

The representative concentrations presented in this section were conservatively estimated as the lower of the 95% UCL of the mean of the data set and the maximum detected value. The representative concentrations were also assumed to remain constant over the chronic exposure duration of the HHRA.

Despite the existence of other sources in the Hillsboro area, it is conservatively assumed that all COPCs are Site-related.

As discussed in Section II.C, 95% UCLs could only be calculated for the compounds identified as COPCs in soil and ground water. Receptors using Lake Hillsboro for drinking water (Off-Site Adult and Child Residents), recreational purposes (Off-Site Recreational Bather), and fishing (Off-Site Recreational Fisher) were evaluated using data from the sample point closest to Lake Hillsboro. Although dilution of COPCs in the Lake would be very large, it was not quantified. Similarly, the maximum concentrations of COPCs in the surface water and sediment samples from the southwestern area of the Site (near the pond) were used as representative concentrations for the Trespasser scenario. Therefore, the representative concentrations selected to represent long-term sediment and surface water exposure concentrations for these receptors are extremely conservative.

2. Uncertainty Related to Exclusion of Non-Detected Compounds

As indicated in Tables 3 through 6, a limited number of analytes that were never positively detected in soil, sediment, ground water, and surface water data sets had detection limits that exceeded their respective RBCs. The majority of these analytes are volatile and semi-volatile organic compounds that are not expected to be associated with the Site based upon historical activities, and indeed were seldom detected in any media. As such, it is not expected that their exclusion from the HHRA will result in underestimation of potential risk/hazard associated with the Site.

III. EXPOSURE ASSESSMENT

The objective of the exposure assessment is to estimate the type, magnitude, frequency, duration, and routes of the potential human exposures to the COPCs identified in Section II,b. The exposure assessment is based upon scenarios that define the conditions of exposure to COPCs. These scenarios are summarized in the exposure pathway CSM presented in Figure 2, which represents our understanding of the sources of COPCs, the means by which they are released and transported within and among media, and the exposure pathways and routes by which they may contact human receptors. The CSM provides the framework for the development of the risk and hazard associated with each COPC, exposure pathway, and receptor. As shown in Figure 2, the CSM includes:

- Known or potential sources of COPCs;
- Environmental media that may be affected by COPCs, including surface water, ground water, soil, sediment, air, and biota;
- Primary and secondary release mechanisms that may be associated with each affected medium;
- Potential exposure pathways for defined receptors, based on collected data or expected pathways; and
- Potential human receptor populations.

A brief discussion of the components of the CSM is presented in the following sections.

A. Sources

Historical industrial activities at the Site are assumed to be the sources of COPCs present in residue piles, soil, sediment, ground water, and surface water.

B. Potential Migration Pathways

Potential migration pathways at the Site were evaluated in the Phase 2 Technical Memorandum (ENVIRON 2003b). With the exception of trichloroethylene in drainageway sediments and surface water, the COPCs in Site media are all metals. The concentration and distribution of COPCs in environmental media on and in the vicinity of the Site could be (and/or could historically have been) affected by one or more of the following general mechanisms, as illustrated in Figures 6 and 7:

- Airborne emissions during historical industrial operations;
- Suspension and transport of particle-associated COPCs in air;
- Suspension and transport of particle-associated COPCs in surface water runoff;
- Leaching of COPCs from residue piles to underlying soil;
- Desorption of COPCs from subsurface soil particles and leaching into underlying ground water;
- Migration of dissolved COPCs in ground water; and
- Ground water-to-surface water transport of COPCs.

As discussed in Section IV.D of the March 2003 Phase 1 Technical Memorandum, available data and information concerning the residue piles indicate that there is no evidence that air deposition has impacted off-Site areas. The prevailing wind direction is from the south and south-southwest. Therefore, any impact would be the greatest in the area immediately north or north-northeast of the areas used for residue storage. A previous investigation conducted by IEPA addressed this issue through the collection of off-Site surficial soil samples (see Section II.C). None of these data suggest that off-Site migration of contaminants through wind deposition has occurred. Since no on-Site soil impacts in the Northern Area of investigation were identified in the Phase I investigation, and existing off-Site data show no impacts, off-Site air erosion of residue piles and subsequent deposition is not considered a viable contaminant transport pathway at the Site.

C. Potential Receptor Populations

Potential receptor populations to be considered include:

- On-Site Commercial/Industrial Workers (present and future);
- On-Site Construction Workers (future);
- Trespassers (present and future);
- Off-Site Residents (present and future);
- Off-Site Recreational Bathers in Lake Hillsboro (present and future); and
- Off-Site Recreational Fishers in Lake Hillsboro (present and future).

Because the Site's historical, current, and anticipated future use is commercial/industrial, the assumption that future residential development of the Site will not occur is considered valid. Accordingly, the most appropriate on-Site exposure scenario is the commercial/industrial worker. The construction worker exposure has also been evaluated to ensure that people engaged in intrusive activities at the Site are protected. Although the magnitude of exposure to any trespassers accessing the Site would be much less than that experienced by workers, this scenario was also considered in the risk assessment in light of evidence that trespassing has occurred at the Site.

The off-Site receptors with potential for exposure to COPCs are area residents and recreational users of water bodies receiving runoff and ground water-to-surface water flow from the Site. The off-Site portion of the Western Drainageway immediately downstream of the southwest pond is not known to be used, nor does it have a reasonable potential to be used, for recreational purposes. The stream is intermittent (has been observed to be nearly dry during summer months) and small (typically 5-6 feet wide and several inches deep when flowing). The portion of the drainageway immediately west of the site is relatively inaccessible, as it is located in an area that is: (1) heavily overgrown with brush; (2) extremely marshy; (3) in a basin that is surrounded to the north, south, and east by steep upward slopes; and (4) located on private property, most of which is owned by Fuller Brothers Concrete. No residential properties are intersected by, or back directly up to the drainageway. Therefore, regular recreational bathing by area residents is to occur only in Lake Hillsboro. Intake of COPCs potentially accumulated in fish tissue by recreational fishers in Lake Hillsboro is also evaluated.

The following exposure scenarios are intended to encompass the spectrum of potential exposures that could plausibly occur at a site intended for commercial/industrial use:

- **On-Site Commercial/Industrial Worker:** represents the long-term adult receptor who works as a full-time employee at the Site and whose typical responsibility is maintenance or other activities performed primarily outdoors. The activities for this receptor might include moderate digging or landscaping in surface to shallow subsurface soil. As the on-Site Commercial/Industrial Worker receptor is expected to be the most highly exposed receptor in the outdoor environment, risk and hazards for this receptor would be expected to be higher than any other on-Site receptor. The point of exposure (POE) for this receptor is identified as any location on-Site.

- **On-Site Construction Worker:** represents adults who have short-term exposure to compounds in soil during a single construction project. If multiple non-concurrent projects are anticipated, it is assumed that different workers will be employed for each project. The activities for this receptor typically involve substantial exposure to both surface and subsurface soils. This receptor is expected to have a higher soil contact rate than the typical commercial/industrial worker. The POE for this receptor is identified as any location on-Site.

- **Trespasser:** represents individuals (assumed to be adolescents aged 12 to 17 years) who make repeated unauthorized entries and wander freely over the Site during the summer. This receptor could be exposed to compounds in on-Site soil, sediment, and surface water. The POE for this receptor for on-Site soil exposure could be anywhere on the Site. The POE considered for exposure to sediment and surface water was considered to be the southwestern stormwater retention pond. As indicated in Section II.C, the maximum concentrations of COPCs in surface water and sediment samples taken in the southwestern area of the Site (near the pond) were used as representative concentrations for this receptor scenario.

- **Off-Site Resident:** represents individuals (adult and child) living in the vicinity whose public water supply system occasionally draws upon Lake Hillsboro (the POE; used as a backup water source for only 1.5 weeks in 2003). These receptors could be exposed through potable use (ingestion and dermal contact), although the limited use of Lake Hillsboro water makes this potentially complete exposure pathway very unlikely to be significant. Off-Site residents are not expected to be present on the Site at any time. As data from the reservoir would be reflective of many inputs, data from the closest surface water sampling point to the reservoir (SW-ED-16) were used to provide a conservative estimate of exposure to COPCs. That is, no dilution within Lake Hillsboro was assumed.

- **Off-Site Recreational Bather:** represents individuals (adult and child) living in the vicinity who regularly swim outdoors during the summer. Because off-Site areas receiving drainage from the southwest area of the Site do not appear to be large or accessible enough to support regular recreational activity, the POE for the Recreational Bather is identified as Lake Hillsboro. Like the Off-Site Resident, data from the surface water sampling point nearest Lake Hillsboro were used to provide a conservative estimate of exposure, without accounting for dilution in the Lake.

- **Off-Site Recreational Fisher:** represents individuals (adult and child) who frequently catch and consume fish from Lake Hillsboro (the POE). In the absence of fish tissue data, fish concentrations were estimated by multiplying the concentrations of COPCs in the surface water sampling point nearest Lake Hillsboro by COPC-specific bioconcentration factors (BCFs). Again, dilution of COPCs in the Lake was not accounted for.

D. Potentially Complete Exposure Pathways

Exposure pathways consist of four elements:

- A source and mechanism(s) of constituent release to the environment;
- An environmental transport medium for the released constituent;
- A point of potential human contact with the affected medium; and
- A route of entry into humans (inhalation, ingestion, or dermal contact with the affected medium).

If any of these components is missing, then the pathway is incomplete and does not contribute to receptor exposure. The rationale for selection of potentially complete exposure pathways to be evaluated in Tier 1 of the HHRA is presented in Table 1 and briefly discussed in the following sections.

1. Exposure to Soil

Direct exposure to on-Site COPCs in soil is possible for receptors located on-Site (commercial/industrial worker, construction worker, and trespasser) via:

- Incidental ingestion of surface and/or subsurface soil;
- Dermal contact with surface and/or subsurface soil; and
- Inhalation of respirable dust particles that have become entrained in the air.

As discussed in Sections III.B and III.C, available data and information indicate that off-Site soils have not been impacted by the Site, and that residue piles are not sources of airborne dust either on- or off-Site.

2. Exposure to Ground Water

The City of Hillsboro has been served by a municipal potable water system since the existing water treatment plant was constructed in 1926. Recent searches of public and private water wells have been conducted by ENVIRON and Philip Environmental Services (summarized in ENVIRON 2002a). The well searches were requested from the Illinois State Water Survey (ISWS), the IEPA, and the Illinois State Geological Survey. Additional information provided by the Montgomery County Health Department and City of Hillsboro officials is also presented in the PSE Report. While there are records of some older domestic wells located within a one-mile radius of the Site, all residents of Hillsboro, as well as unincorporated areas located within one mile of the Site, are provided with public water.

The ISWS search showed a group of private wells located in an area immediately west of Lake Hillsboro. According to Hillsboro Mayor William

Baran, this area, known as Lakewood Knolls, was connected to the public water supply during the 1980s and 1990s, either at the time the homes were built, or later, when the municipal water lines were installed in these areas. The small older residential area located in the same area, but south of Smith Road, is also supplied with public water. According to a local ordinance, "...any connection whereby a private, auxiliary or emergency water supply other than the regular public water supply enters the supply or distribution system of the City..." is prohibited. According to Mr. Scott Hunt of Hurste-Roche, Inc., the City's engineering firm, the prohibition of cross-connections would preclude the use of a separate domestic well water system within a household that is connected to the municipal water system. Although local officials have indicated that some older domestic wells may be used for non-potable outdoor purposes (*e.g.*, watering lawns and gardens), it is unlikely that significant ingestion occurs, and there is no expectation that ground water resources will be developed for potable use in the foreseeable future.

Based on the available information, it is concluded that potable ground water is not a complete exposure pathway. Since no volatile organic compounds were detected above RBCs, the volatilization from the ground water exposure pathway was also considered to be incomplete.

Discharge of ground water into surface water bodies could be a source of COPCs to on- and off-Site surface water bodies. The bulk of the Site's ground water is believed to flow either southwestward (towards and parallel with the Western Drainageway) or eastward/southeastward (towards and parallel with the Eastern Drainageway) (ENVIRON 2003b) (Figures 6 and 7). On-Site areas within the Eastern Drainageway include large non-operational areas (*e.g.*, Northern Area and areas east of the Manufacturing Area) and lack significant source areas, such as residue piles. The fact that no dissolved metals were detected above applicable ground water screening levels in these wells (ENVIRON 2003b) reflects the lack of source areas that could impact ground water in the areas east of the Site. Thus, available data indicate that ground water flow to the Eastern Drainageway and Lake Hillsboro is not a significant exposure pathway. Based on the limited off-Site extent of ground water impacted by dissolved metals concentrations to the southwest of the Site, it is similarly concluded that discharge of ground water is not a significant pathway for the off-Site transport of COPCs to the southwest.

Finally, construction workers engaged in intrusive activities on the Site could come into direct contact with ground water in excavations. This exposure pathway is expected to be trivial due to the low level of expected exposure and the relative lack of dermal permeation by metals, the only COPCs. Nonetheless, it was quantitatively considered in the HHRA as a potentially complete exposure pathway.

3. Exposure to Surface Water

Surface water impact could occur due to COPCs being carried off-Site in storm water runoff (Figures 6 and 7). In May 2003, the IEPA terminated the Site's National Pollutant Discharge Elimination System (NPDES) Permit, which regulated storm water discharges from the former plant to both the eastern and western storm water outfalls, because, according to the IEPA's May 23, 2003 *Public Notice/Fact Sheet of Intent to Terminate NPDES Permit No. IL0074519*, "...the facility has closed, all industrial activity has ceased, and the discharges have ceased."

Although significant off-Site transport may no longer be occurring, individuals could encounter COPCs in surface water impacted by historical releases during recreational activities (i.e., Trespassers in the area of the southwest pond and Off-Site Recreational Bathers in Lake Hillsboro) or through consumption of fish caught in Lake Hillsboro (Off-Site Fishers). As mentioned previously, in the absence of fish tissue data, concentrations were estimated by multiplying the representative concentrations of COPCs at the surface water sampling point nearest Lake Hillsboro by COPC-specific BCFs.

Nearby off-Site residents whose public water occasionally draws upon Lake Hillsboro could be exposed through domestic use (ingestion and dermal contact), although as noted previously, the limited use of Lake Hillsboro water (used as a backup water source for only 1.5 weeks in 2003) makes this potentially complete exposure pathway very unlikely to be significant.

4. Exposure to Sediment

Sediment in the nearby creeks and ponds, both on- and off-Site, may have been impacted by compounds contained in the runoff from storm water events. As discussed previously (Section III.D.3), available data suggest that off-Site impacts are related to historical surface water runoff from the Site rather than ongoing discharges. Nonetheless, both Trespassers who may swim in the southwest pond area and Off-Site Recreational Bathers of Lake Hillsboro could be exposed through incidental ingestion of sediment impacted by historical releases. Because dermal contact with sediment is expected to be of insufficient quantity and duration to result in significant exposure, it was not considered quantitatively in the HHRA.

E. Selection of Exposure Parameter Values for Calculation of Tier 1 Screening Levels

Exposure parameters are variables that describe the physical characteristics and medium contact rates of the populations selected for evaluation. A combination of high-end and central tendency values for exposure and physical parameters were selected so that in combination, they result in an estimate of the RME for each pathway. The RME is intended to be representative of high-end (but not worst-case) exposures. In most cases, published exposure parameter values were incorporated in this risk evaluation; where default values were lacking, professional judgment was relied upon to achieve a similar level of conservatism. The exposure parameter values used in this HHRA for each receptor, along with their technical basis, are presented in Tables 9 through 14. These exposure parameter values, along with other compound and site-specific information, were used to develop the Tier 1 screening levels described in Section V.

F. Uncertainties Related to Exposure Assessment

Each of the assumptions made and parameter values used to estimate the magnitude of exposure for the human exposure scenarios considered has associated uncertainty and variability. To ensure that potential risks to human health are not underestimated, most of these assumptions and values were deliberately intended to overestimate potential exposure:

- The exposure pathways evaluated were those expected to have the largest impact on risk and hazard;

- Parameter values intended to result in RME exposure estimates were selected for all potentially complete pathways;

- As discussed in Section II.C, the representative concentrations were conservatively estimated as the lower of the 95% UCL of the mean of the data set or the maximum detected value; and

- As noted above, (Section III.C) COPC concentrations in fish tissue were estimated in the absence of monitoring data by applying published BCFs. In the case of zinc, an essential metal, the BCF is not useful for relating uptake to adverse effects because zinc is (and must be) naturally concentrated by living organisms. Further, the fact that many organisms are capable of regulating internal zinc concentrations means that they are physiologically equipped to compensate for perturbations or high concentrations in the external environment. Thus, zinc tissue concentrations do not necessarily reflect ambient concentrations and, in contrast to those for lipophilic organic compounds, zinc BCFs cannot be considered to be constant ratios between tissue concentrations and external water concentrations. Accumulation of zinc to meet physiological requirements should not be mistaken for trophic transfer; it is not biomagnified (Beyer 1986; Suedel et al. 1994; WHO 2001).

Taken together, these conservative assumptions are highly likely to result in overestimation of exposure to the receptor populations considered in this HHRA, to an unknown but probably significant degree.

IV. TOXICITY ASSESSMENT

The toxicity assessment characterizes the relationship between the magnitude of exposure to a COPC and the nature and magnitude of adverse health effects that may result from such exposure. Toxicity criteria for use in risk assessment may be based on epidemiological studies, short-term human studies, or subchronic or chronic animal data. Toxicity criteria for COPCs at the Site were selected (in order of preference in accordance with EPA 2003b) from the following sources: (1) EPA's Integrated Risk Information System (IRIS) (EPA 2004b); (2) EPA's provisional peer-reviewed toxicity values developed by the Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center; and (3) EPA's *Health Effects Assessment Summary Tables* (HEAST) (EPA 1997d) and other tertiary sources. The systemic and carcinogenic effects of TCE have been under EPA review for a number of years, and recently proposed values (EPA 2001b) are being reevaluated. In the absence of approved toxicity criteria for this compound, both withdrawn and proposed values will be used in the HHRA.

Chemical toxicity is divided into two categories, carcinogenic and non-carcinogenic, based on the type of adverse health effect exerted. Health risks are calculated differently for these two types of effects because their toxicity criteria are based on different mechanistic assumptions and expressed in different units. The two approaches are discussed below.

A. Toxicity Indicators for Non-Carcinogenic Effects

A non-carcinogenic effect is defined as any adverse response to a chemical that is not cancer. Any chemical can cause adverse health effects if given at a high enough doses. When the dose is sufficiently low, no adverse effect is observed. Thus, in characterizing the non-cancer effects of a chemical, the key parameter is the threshold dose at which an adverse effect first becomes evident. Doses below the threshold are considered to be "safe" (*i.e.*, not associated with adverse effects), while doses above the threshold may cause an adverse effect.

The threshold dose is typically estimated from toxicological data (derived from studies of humans and/or animals) by finding the highest dose that does not produce an observable adverse effect (the "No-Observed-Adverse-Effect-Level (NOAEL)) and the lowest dose at which an adverse effect is observed (the "Lowest-Observed-Adverse-Effect-Level (LOAEL)). The threshold dose is presumed to lie in the interval between the NOAEL and the LOAEL. In order to be conservative or protective of particularly sensitive potential receptors, non-cancer risk evaluations are not based directly on the threshold exposure level, but on a value referred to as the Reference Dose (RfD).

An RfD is an estimate of the daily lifetime exposure level to humans (expressed in units of mg of chemical/kg of body weight/day), including sensitive subgroups, that is likely to be without appreciable risk of deleterious effects (EPA 1989). Reference concentrations (RfCs) are concentrations in air (in units of mg per cubic meter – mg/m^3) that an individual may be exposed to every day for a lifetime without harm. RfDs and RfCs are usually derived from NOAELs (or LOAELs, if reliable NOAELs are not available) from studies in the most sensitive species, strain, and sex of experimental animal known, the assumption being that humans are no more sensitive than the most sensitive animal species tested. These criteria incorporate a series of uncertainty factors representing inter- and intraspecies variability and the quality and completeness of the toxicological database. These uncertainty factors (with one exception) are assigned a value of at least 10. If human studies are available and the observations considered reliable, the uncertainty factor may be as small as 1. The effect of dividing the NOAEL or the LOAEL by the product of all the uncertainty factors is to ensure that the RfD or RfC is not higher than the threshold level for adverse effects in the most sensitive potential receptor. Thus, there is a "margin of safety" built into an RfD or RfC, and doses equal to or less than the RfD or RfC are nearly certain to be without any adverse effect. The likelihood of an adverse effect at doses higher than the RfD or RfC increases, but because of the margin of safety, a dose above the criterion does not mean that such an effect will necessarily occur.

Under the guidelines established by the Superfund program, exposures to construction workers of one year or less are classified as subchronic (defined as less than seven years [EPA 1989]). Because this is short relative to the working lifetime (25 years) generally assumed for workers, it is appropriate to evaluate potential non-cancer hazard by comparison of estimated exposure with toxicity values for subchronic, not chronic, effects (EPA 2002a). Accordingly, subchronic values have been used as available in this risk assessment. In the absence of subchronic values for COPCs, chronic values were used.

Current non-carcinogenic toxicity information for the identified COPCs (up-to-date as of March 2004) is presented in Table 15, and physicochemical properties are listed in Table 16. In the case of exposure by dermal contact with soil, if the compound-specific gastrointestinal absorption factor (ABS_{GI}) value (Table 16) is less than 50%, the RfD will be multiplied by the ABS_{GI}. If the ABS_{GI} is greater than or equal to 50%, then the reported oral RfD, will be used. The RfDs for cadmium, manganese, vanadium, and zinc were adjusted to account for gastrointestinal absorption. Available subchronic non-cancer toxicity values, indicated in Table 15, were used for the construction worker scenario.

B. Toxicity Indicators for Carcinogenic Effects

Cancers are generally defined as diseases of mutation affecting cell growth and differentiation. In contrast to non-carcinogenic effects, EPA traditionally assumes that there is no threshold for carcinogenic responses; that is, any dose of a carcinogen is considered to pose some finite risk of cancer. The evidence for human carcinogenicity of a chemical is derived from two sources: chronic studies with laboratory animals and human epidemiology studies where an increased incidence of cancer is associated with exposure to the chemical. The EPA typically assumes that negative epidemiological data are not evidence that a chemical is not carcinogenic in humans.

Since risks at the low levels of exposure usually encountered by humans are difficult to quantify directly by either animal or epidemiological studies, mathematical models are used to extrapolate from high experimental to low environmental doses. The slope of the extrapolated dose-response curve is used to calculate the cancer slope factor (CSF), which defines the incremental lifetime cancer risk per unit of carcinogen (in units of risk per mg/kg/day). The linearized multi-stage model for low-dose extrapolation most often used by EPA (EPA 1986, 2003a) is one of the most conservative available, and leads to an upper-bound estimate of risk (the 95% UCL of the modeled animal dose-response slope). Under the assumption of dose-response linearity at low doses, the probability that the true potency is higher than that estimated is thus only 5 percent. Actual potency (and resultant risk) is likely to be lower, and could even be zero (EPA 1986). Recent guidance provides for derivation of dose-response relationship using alternative low-dose-response extrapolation procedures as indicated by the nature and quality of the database (EPA 2003a).

Current carcinogenic toxicity information for the identified COPCs (up-to-date as of March 2004) is presented in Table 15. In the case of exposure by dermal contact with soil, if the compound-specific ABS_{GI} value (Table 16) is less than 50%, the CSF will be divided by the ABS_{GI}. If the ABS_{GI} is greater than or equal to 50%, then the reported oral CSF will be used. None of the CSFs presented in Table 15 were adjusted to account for gastrointestinal absorption.

C. Lead

The EPA has deemed it inappropriate to develop either an RfD or a CSF for inorganic lead. A great deal of information on the health effects of lead has been obtained over the past 60 years of medical observation and scientific research. Inorganic lead may be absorbed by inhalation or by ingestion. Absorption by either route contributes in an additive fashion to the total body burden. Infants are born with a lead burden (lead present in their body) that primarily reflects the mothers' past exposure. Infants and children are exposed to lead mainly from ingestion of food and beverages and the ingestion of non-food materials by normal early mouthing behavior. The impact that the mouthing behavior has on the blood lead level depends on the levels of lead in house dust, soil, and paint. Most adults are exposed to lead primarily from dietary sources (food and water), but occupational exposure to lead may be significant in some circumstances.

Instead of dose-based toxicity criteria, potential risk associated with lead exposure is assessed by means of blood lead levels. The EPA has established a target blood lead level for children less than eight years of age, who are particularly susceptible to lead toxicity, of no more than 10 µg/dL for both short- and long-term exposures. This level is based on the occurrence of enzymatic alterations in erythrocytes at blood lead levels below 25 µg/dL and by reports of neurologic and cognitive dysfunction in children at blood lead levels between 10 and 15 µg/dL (ATSDR 1997). Using an integrated exposure uptake-biokinetic (IEUBK) model that is specifically designed to predict blood lead levels, a lead concentration in soil at which there is no more than a 5 percent chance that exposure would result in exceedance of the target blood lead level for children (10 µg/dL) is 400 mg/kg (EPA 1994a).

D. Uncertainties Related to Toxicity Assessment

The uncertainties associated with dose-response relationships and weight-of-evidence carcinogenicity classification is generally much greater than those associated with other elements of risk assessment. The extrapolation of high-dose animal bioassay or occupational exposure study results to estimate human risk at much lower levels of exposure involves a number of conservative assumptions regarding effects thresholds, interspecific responses, high- to low-dose extrapolation, and route-to-route extrapolation. The scientific validity of these assumptions is uncertain; because each of the individual extrapolations are designed to prevent underestimation of risk, in concert they result in unquantifiable but potentially very large overestimation of risk/hazard. Other sources of uncertainty in the toxicity assessment that could result in over- or underestimation of risks include:

- Extrapolation of oral RfDs and CSFs to other exposure routes;
- Use of toxicity criteria that have been withdrawn or do not represent EPA consensus values (*e.g.*, trichloroethylene); and
- Extrapolation among exposure media, which introduces uncertainty due to lack of knowledge of matrix effects on chemical bioavailability.

V. DEVELOPMENT OF TIER 1 SCREENING LEVELS

Equations used for calculating Tier 1 screening levels for the potentially complete exposure pathways at the Site are discussed in the following sections. RME exposure parameter values for each receptor scenario are presented along with sources in Tables 9 through 14, toxicity criteria are listed in Table 15, and other required chemical/physical properties for COPCs are displayed in Table 16. The target hazard quotient (THQ) is 1, and the target cancer risk level (TR) is 10^{-6}, the lower bound of EPA's acceptable risk range of 10^{-6} to 10^{-4} (EPA 1991b).

Receptor scenario-specific Tier 1 screening levels for the On-Site Commercial/Industrial Worker, On-Site Construction Worker, Trespasser, Off-Site Recreational Bather, Off-Site Resident, and Off-Site Fisher are presented in Tables 17, 18, 19, 20, 21, and 22, respectively.

A. Soil and Sediment

Tier 1 screening levels for direct contact with surface and subsurface soil and sediment via individual exposure routes (soil ingestion, dermal contact, and inhalation of particles) were calculated for all on-Site receptor scenarios and the Off-Site Recreational Bather. Because the duration of exposure for the On-Site Construction Worker scenario is subchronic (defined as less than seven years [EPA, 1989]), subchronic toxicity criteria (EPA 1997d), as available, were used instead of chronic RfDs in calculating Tier 1 screening levels.

1. Incidental Ingestion of Soil and Sediment

Tier 1 screening levels for incidental ingestion of soil by On-Site Commercial/Industrial Workers and Construction Workers and incidental ingestion of soil and sediment by Trespassers were calculated in accordance with Equation {1}:

$$ {}^{\text{Ingestion}}SL_{\text{Soil / Sed}} = \frac{\text{THQ or TR} \cdot \text{BW} \cdot \text{AT} \cdot 365\,\text{days/yr} \cdot [\text{RfD or } 1/\text{CSF}]}{\text{ED} \cdot \text{EF} \cdot 10^{-6}\,\text{kg/mg} \cdot \text{SIR or SedIR}} \qquad \{1\} $$

The equation used to calculate Tier 1 screening levels for incidental sediment ingestion by the combined child and adult Recreational Bather is:

$$^{\text{Ingestion}}SL_{Sed} = \frac{THQ \text{ or } TR \cdot AT \cdot 365\,\text{days/yr} \cdot [RfD \text{ or } 1/CSF]}{EF \cdot 10^{-6}\,\text{kg/mg} \cdot SedIR_{adj}} \quad \{2\}$$

The age-adjusted sediment intake rate ($SedIR_{adj}$) was calculated by analogy to the equation used by EPA to estimate age-adjusted soil intake rates (EPA 1991a):

$$SedIR_{adj} = \frac{SedIR_a \cdot ED_a}{BW_a} + \frac{SedIR_c \cdot ED_c}{BW_c} \quad \{3\}$$

where:

Parameter	Units	Description
$^{\text{Ingestion}}SL_{Soil/Sed}$ [a]	mg/kg	Tier 1 Screening Level for incidental ingestion of soil or sediment
BW	kg	Body weight [population-specific]
BW_c	kg	Child body weight [population-specific]
BW_a	kg	Adult body weight [population-specific]
AT	yrs	Averaging time [population-specific]
CSF	$(mg/kg\text{-}day)^{-1}$	Oral carcinogenic slope factor [chemical-specific]
RfD	mg/kg-day	Chronic or subchronic oral reference dose [chemical-specific]
ED	yrs	Exposure duration [population-specific]
ED_c	yrs	Child exposure duration [population-specific]
ED_a	yrs	Adult exposure duration [population-specific]
EF	days/yr	Exposure frequency [population-specific]
SIR/SedIR	mg/day	Incidental ingestion rate of soil or sediment [population-specific]
$SedIR_c$	liter/day	Child ingestion rate of sediment while swimming
$SedIR_a$	liter/day	Adult ingestion rate of sediment while swimming
$SedIR_{adj}$	mg-yr/kg-day	Age-adjusted sediment intake rate [population-specific]
THQ	unitless	Target hazard quotient
TR	unitless	Target cancer risk level

[a] Equation{1} as presented in EPA (2002a) rearranged to solve for incidental ingestion only

2. Dermal Contact with Soil

Tier 1 screening levels for dermal contact with soil by On-Site Commercial/Industrial Workers, Construction Workers, and Trespassers were calculated in accordance with Equation{4}:

$$^{\text{DermalContact}}SL_{Soil} = \frac{THQ \text{ or } TR \cdot BW \cdot AT \cdot 365\,\text{days/yr} \cdot [RfD \text{ or } 1/CSF]}{ED \cdot EF \cdot 10^{-6}\,\text{kg/mg} \cdot AF \cdot SA \cdot EV \cdot ABS_d} \quad \{4\}$$

where:

Parameter	Units	Description
${}^{DermalContact}SL_{Soil}{}^{a}$	mg/kg	Tier 1 Screening Level for dermal contact with soil
BW	kg	Body weight [population-specific]
AT	yrs	Averaging time [population –specific]
CSF	$(mg/kg\text{-}day)^{-1}$	Dermal carcinogenic slope factor [chemical-specific]
RfD	mg/kg-day	Dermal reference dose [chemical-specific]
ED	yrs	Exposure duration [population-specific]
EF	days/yr	Exposure frequency [population-specific]
AF	mg/cm^2	Skin-soil adherence factor [population-specific]
SA	cm^2/event	Skin surface area exposure [population-specific]
EV	event/day	Event frequency [population-specific]
ABS_d	unitless	Dermal absorption factor [chemical-specific]
THQ	unitless	Target hazard quotient
TR	unitless	Target cancer risk level

[a] Equation {4} as presented in EPA (2002a) rearranged to solve for dermal contact only

3. Inhalation of Airborne Soil Particles

Tier 1 screening levels for inhalation of airborne soil particles soil by On-Site Commercial/Industrial Workers, Construction Workers, and Trespassers were calculated in accordance with Equation{5}:

$$ {}^{Inhalation}SL_{Soil} = \frac{THQ \text{ or } TR \cdot AT \cdot 365\,days/yr \cdot \left[RfC \text{ or } \left((1/URF)\cdot 10^{-3}\,mg/\mu g\right)\right]}{EF \cdot ED \cdot \left(\frac{1}{PEF}\right)} \quad \{5\} $$

where:

Parameter	Units	Description
${}^{Inhalation}SL_{a}$	mg/kg	Tier 1 Screening Level for inhalation of volatile compounds in soil or airborne particulates originating from soil
AT	yrs	Averaging time (equal to AT_{nc} for non-carcinogenic evaluation and AT_c for carcinogenic evaluation) [population-specific]
URF	$(\mu g/m^3)^{-1}$	Inhalation unit risk factor [chemical-specific]
RfC	mg/m^3	Inhalation reference concentration [chemical-specific]
EF	days/yr	Exposure frequency outdoor [population-specific]
ED	yrs	Exposure duration [population-specific]
PEF	m^3/kg	Particulate emission factor [calculated]
THQ	unitless	Target hazard quotient
TR	unitless	Target cancer risk level

[a] Equation as presented in EPA (2002a)

The particulate emission factor (PEF), which is used to estimate the inhalation of wind blown particulates, was determined using the equation:

$$\text{PEF} = \frac{Q/C_{wind} \cdot 3600\,\text{sec/hr}}{0.036 \cdot (1-V) \cdot \left(U_m/U_t\right)^3 \cdot F(x)} \qquad \{6\}$$

where:

Parameter	Units	Description
PEF[a]	m^3/kg	Particulate emission factor
Q/C_{wind}	$(g/m^2\text{-sec})/(kg/m^3)$	Inverse of mean concentration at center of a 132-acre square source [=41][b]
V	unitless	fraction of vegetative cover [=0.5 default]
U_m	m/sec	Mean annual wind speed [=4.69 default]
U_t	m/sec	Equivalent threshold value of wind speed at 7 m [=11.32 default]
F(x)	unitless	Function dependent on U_m/U_t derived using Cowherd *et al.* (1985) [=0.194 default]

[a] As specified in Equation B-8 of EPA (2002a)

[b] Based upon the equation presented in Exhibit D-2 of EPA (2002a) using constants for Chicago, Illinois and a source area size of 132 acres.

4. Lead in Sediment

Lead is a COPC in sediment (Table 7). As noted in Section IV.C, the EPA has established a target blood lead level for children less than eight years of age, who are particularly susceptible to lead toxicity, of no more than 10 µg/dL for both short- and long-term exposures. Using an IEUBK model that is specifically designed to evaluate blood lead levels in children, EPA has determined that 400 mg/kg represents the residential soil concentration at which there is no more than a 5% chance that the target blood lead level for children will be exceeded (EPA 1994b). As noted in Section IV.C, this value was also selected for COPC screening. No comparable screening level is available for evaluation of a receptor exposed to lead contained in sediment. Due to the significant behavioral and physiological differences between young children and older people, the IEUBK model does not allow estimation of blood lead levels for persons older than eight years of age or for less than 350 days/year exposure frequency (EPA 1994a). Thus, modification of this value to match recreational and trespasser exposure scenarios is not appropriate. Therefore, 400 mg/kg was also used as a highly conservative screening level for sediment.

B. Surface Water and Ground Water

The equations in the following sections were used to calculate Tier 1 screening levels for:

- Direct contact with surface water via various individual exposure routes (incidental ingestion while swimming, ingestion as a potable source, and dermal contact) for Trespassers, Off-Site Recreational Bathers, and Off-Site Residents;
- Ingestion of fish in Lake Hillsboro by Off-Site Fishers; and
- Dermal contact with ground water in excavations for the On-Site Construction Worker scenario.

1. Incidental Ingestion of Surface Water While Swimming

Tier 1 screening levels for incidental ingestion of surface water while swimming by Trespassers were calculated in accordance with Equation{7}:

$$^{\text{Ingestion}}SL_{SW} = \frac{THQ \text{ or } TR \cdot BW \cdot AT \cdot 365\,\text{days/yr} \cdot [RfD \text{ or } 1/CSF]}{ED \cdot EF \cdot {}^{\text{swim}}WIR} \qquad \{7\}$$

The equation used to calculate Tier 1 screening levels for incidental surface water ingestion while swimming by the combined child and adult Recreational Bather is:

$$^{\text{Ingestion}}SL_{SW} = \frac{THQ \text{ or } TR \cdot AT \cdot 365\,\text{days/yr} \cdot [RfD \text{ or } 1/CSF]}{EF \cdot {}^{\text{swim}}WIR_{adj}} \qquad \{8\}$$

The age-adjusted incidental surface water intake rate while swimming (${}^{swim}WIR_{adj}$) was calculated in accordance with EPA Region 3 guidance (EPA Region 3 2003b):

$$^{\text{swim}}WIR_{adj} = \frac{{}^{\text{swim}}WIR_a \cdot ED_a}{BW_a} + \frac{{}^{\text{swim}}WIR_c \cdot ED_c}{BW_c} \qquad \{9\}$$

where:

Parameter	Units	Description
${}^{Ingestion}SL_{SW}$ [a]	mg/liter	Tier 1 Screening Level for incidental ingestion of surface water while swimming
BW	kg	Body weight [population-specific]
BW_c	kg	Child body weight [population-specific]
BW_a	kg	Adult body weight [population-specific]
AT	yrs	Averaging time [population-specific]
CSF	$(mg/kg\text{-}day)^{-1}$	Oral carcinogenic slope factor [chemical-specific]
RfD	mg/kg-day	Oral reference dose [chemical-specific]
ED	yrs	Exposure duration [population-specific]
ED_c	yrs	Child exposure duration [population-specific]
ED_a	yrs	Adult exposure duration [population-specific]
EF	days/yr	Exposure frequency [population-specific]
${}^{swim}WIR$	liter/day	Incidental surface water intake rate while swimming [population-specific]
${}^{swim}WIR_a$	liter/day	Adult ingestion rate of surface water while swimming
${}^{swim}WIR_c$	liter/day	Child ingestion rate of surface water while swimming
${}^{swim}WIR_{adj}$ [b]	L-yr/kg-day	Age-adjusted surface water intake rate while swimming
THQ	unitless	Target hazard quotient
TR	unitless	Target cancer risk level

[a] Equation{7} from EPA (1989), Exhibit 6-12, rearranged to calculate risk-based screening level

[b] Calculated per Equation (2), EPA Region 3 (2003b)

2. Ingestion of Potable Surface Water by Off-Site Residents

Tier 1 screening levels for ingestion of potable surface water by the combined child and adult Off-Site Resident were calculated in accordance with Equation{10}:

$$ {}^{Ingestion}SL_{SW} = \frac{THQ \text{ or } TR \cdot AT \cdot 365 \text{days/yr} \cdot [RfD \text{ or } 1/CSF]}{EF \cdot WIR_{adj}} \qquad \{10\} $$

The age-adjusted water intake rate (WIR_{adj}) was calculated in accordance with EPA Region 3 guidance (EPA Region 3 2003b):

$$ WIR_{adj} = \frac{WIR_a \cdot ED_a}{BW_a} + \frac{WIR_c \cdot ED_c}{BW_c} \qquad \{11\} $$

where:

Parameter	Units	Description
${}^{Ingestion}SL_{SW}$[a]	mg/liter	Tier 1 Screening Level for ingestion of surface water as a potable drinking source
AT	yrs	Averaging time [population-specific]
CSF	$(mg/kg\text{-}day)^{-1}$	Oral carcinogenic slope factor [chemical-specific]
RfD	mg/kg-day	Oral reference dose [chemical-specific]
EF	days/yr	Exposure frequency [population-specific]
BW_c	kg	Child body weight [population-specific]
BW_a	kg	Adult body weight [population-specific]
ED_c	yrs	Child exposure duration [population-specific]
ED_a	yrs	Adult exposure duration [population-specific]
WIR_a	liter/day	Adult ingestion rate of potable surface water [population-specific]
WIR_c	liter/day	Child ingestion rate of potable surface water [population-specific]
WIR_{adj}[b]	liter-yr/ day-kg	Age-adjusted water ingestion rate
THQ	unitless	Target hazard quotient
TR	unitless	Target cancer risk level

[a] Equation as presented in USEPA (1989), Exhibit 6-11
[b] Calculated per Equation (2), EPA Region 3 (2003b)

3. Dermal Contact with Surface Water or Ground Water

Tier 1 screening levels for dermal contact with surface water (Trespasser) and ground water (On-Site Construction Worker) were calculated in accordance with Equation{12}:

$$ {}^{DermalContact}SL_{SW/GW} = \frac{THQ \text{ or } TR \cdot BW \cdot AT \cdot 365\,days/yr \cdot [RfD_d \text{ or } 1/CSF_d]}{DA_{event} \cdot ED \cdot EF \cdot EV \cdot SA \cdot FSA \cdot 0.001 \cdot liter/cm^3} \qquad \{12\} $$

where:

Parameter	Units	Description
${}^{DermalContact}SL_{SWGW}$[a]	mg/kg/day	Tier 1 Screening Level for dermal contact with surface water
BW	kg	Body weight [population-specific]
AT	yrs	Averaging time [population-specific]
CSF_d	$(mg/kg\text{-}day)^{-1}$	Dermal carcinogenic slope factor [chemical-specific]
RfD_d	mg/kg-day	Dermal reference dose [chemical-specific]
DA_{event}	cm/event	Absorbed dose per event [calculated see Exhibit 4-6a and 4-6b]
ED	yrs	Exposure duration [population-specific]
EF	days/yr	Exposure frequency [population-specific]
EV	events/day	Event frequency [population-specific]
SA	cm^2	Total skin surface area [population-specific]
FSA	unitless	Fraction of skin surface area available for exposure [population-specific]
THQ	unitless	Target hazard quotient
TR	unitless	Target cancer risk level

[a] Equation{12} as presented in EPA (2001a), Equation 3.1.

The approach used to estimate the absorbed dose per event varies depending on whether the compound of interest is inorganic or organic. For inorganic COPCs, dermal absorbed dose per event is calculated as:

$$^{inorg}DA_{event} = K_p \cdot t_{event} \qquad \{13\}$$

For organic COPCs, the method used to calculate dermal absorbed dose per event depends on the chemical-specific lag time per event (τ_{event}). At the Site, the only organic COPC in surface water is trichloroethylene. Because this compound under assumed scenario conditions satisfies the condition that event duration (t_{event}) be less than or equal to the time required to reach steady-state (that is, the conservatively assumed event duration, 1 hour (Table 11), is less than the estimated time to reach steady state (t*; calculated as 2.4 x the lag time per event (0.58 hr/event) (EPA 2001a; Table 17)), or 1.4), the following equation was used to calculate dermal absorbed dose per event:

$$^{org}DA_{event} = 2 \cdot FA \cdot K_p \cdot \sqrt{\frac{6 \cdot \tau_{event} \cdot t_{event}}{\pi}} \qquad \{14\}$$

where:

Parameter	Units	Description
$^{inorg}DA_{event}$ [a]	cm/event	Dermal absorbed dose per event for inorganic compounds
$^{org}DA_{event}$ [b]	cm/event	Dermal absorbed dose per event for organic compounds
FA	unitless	Fraction absorbed water [chemical-specific]
K_p	cm/hr	Dermal permeability coefficient of compound in water [chemical-specific]
t_{event}	hr/event	Event duration [population-specific]
t^*	hr	Time to reach steady-state [calculated as $2.4 \cdot \tau_{event}$]
τ_{event}	hr/event	Lag time per event [chemical-specific]

[a] Equation {13} as presented in EPA (2001a), Equation 3.4, with compound concentration in water (C_w) removed

[b] Equation {14} as presented in EPA (2001a), Equation 3 2, with compound concentration in water (C_w) removed

For the combined adult and child exposure scenarios (Off-Site Residents and Recreational Bathers), Tier 1 screening levels for dermal contact with surface water were calculated as:

$$^{DermalContact}SL_{SW} = \frac{THQ \text{ or } TR \cdot AT \cdot 365\,days/yr \cdot [RfD_d \text{ or } 1/CSF_d]}{DA_{event} \cdot EF \cdot EV \cdot SAF_{adj} \cdot FSA \cdot 0.001 \cdot liter/cm^3} \qquad \{15\}$$

The age-adjusted dermal surface area factor (SAF_{adj}) was calculated in accordance with EPA guidance (EPA 2001a):

$$SAF_{adj} = \frac{SA_a \cdot ED_a}{BW_a} + \frac{SA_c \cdot ED_c}{BW_c} \qquad \{16\}$$

where:

Parameter	Units	Description
${}^{DermalContact}SL_{SW}{}^{a}$	mg/kg/day	Tier 1 Screening Level for Dermal Contact with Surface Water
AT	yrs	Averaging time [population-specific]
BW_c	kg	Child body weight [population-specific]
BW_a	kg	Adult body weight [population-specific]
CSF_d	$(mg/kg\text{-}day)^{-1}$	Dermal carcinogenic slope factor [chemical-specific]
RfD_d	mg/kg-day	Dermal reference dose [chemical-specific]
DA_{event}	cm/event	Absorbed dose per event [calculated see Exhibit 4-6a and 4-6b]
ED_c	yrs	Child exposure duration [population-specific]
ED_a	yrs	Adult exposure duration [population-specific]
EF	days/yr	Exposure frequency [population-specific]
EV	events/day	Event frequency [population-specific]
FSA	unitless	Fraction of skin surface area available for exposure [population-specific]
SA_a	cm^2	Adult surface area exposed to water [population-specific]
SA_c	cm^2	Child surface area exposed to water [population-specific]
SAF_{adj}	cm^2-yr/kg	Age-adjusted dermal surface area factor for swimming or bathing
THQ	unitless	Target hazard quotient
TR	unitless	Target cancer risk level

[a] Equation{15} modified from Equation 3.1 in EPA (2001a) to account for exposure as child and adult

DA_{event} in Equation{15} is as defined in Equations {13} and{14}.

4. Ingestion of Recreationally Caught Fish

Tier 1 screening levels for ingestion of fish by combined child and adult Off-Site Recreational Fishers were calculated in accordance with Equation{17}:

$${}^{Fish}SL_{SW} = \frac{THQ \text{ or } TR \cdot AT \cdot 365\,days/yr \cdot [RfD \text{ or } 1/CSF]}{EF \cdot BCF \cdot FIR_{adj}} \qquad \{17\}$$

The age-adjusted fish intake rate (FIR_{adj}) was calculated by analogy to the equations used by EPA to estimate other age-adjusted intake rates:

$$FIR_{adj} = \frac{FIR_a \cdot ED_a}{BW_a} + \frac{FIR_c \cdot ED_c}{BW_c} \qquad \{18\}$$

where:

Parameter	Units	Description
$^{Fish}SL_{SW}$[a]	mg/L	Tier 1 Screening Level for ingestion of fish
AT	yrs	Averaging time [population-specific]
BW	kg	Body weight [population-specific]
BW_c	kg	Child body weight [population-specific]
BW_a	kg	Adult body weight [population-specific]
BCF	L/kg	Bioconcentration factor [chemical-specific]
CSF	$(mg/kg\text{-}day)^{-1}$	Oral carcinogenic slope factor [chemical-specific]
RfD	mg/kg-day	Oral reference dose [chemical-specific]
ED_c	yrs	Child exposure duration [population-specific]
ED_a	yrs	Adult exposure duration [population-specific]
EF	days/yr	Exposure frequency [population-specific]
FIR_c	gm/day	Child recreational fish ingestion rate
FIR_a	gm/day	Adult recreational fish ingestion rate
FIR_{adj}	gm/day	Age-adjusted recreational fish ingestion rate
THQ	unitless	Target hazard quotient
TR	unitless	Target cancer risk level

[a] Equation{17} as presented in EPA (1989), rearranged and modified to solve for intake due to ingestion as child and adult.

VI. TIER 1 RISK CHARACTERIZATION

Risk characterization involves estimating the magnitude of the potential adverse health effects of the hazardous constituents under study and making summary judgments about the nature of the health threat to the defined receptor populations. It combines the results of the dose-response (toxicity) and exposure assessments to provide numerical estimates of health risk. Risk characterization also considers the nature and weight of evidence supporting these risk estimates as well as the magnitude of uncertainty surrounding such estimates.

In the Tier 1 risk characterization, Tier 1 screening levels for each COPC and medium were compared with representative concentrations in corresponding media to calculate Tier 1 hazard quotients (T1HQs) for non-carcinogenic effects and Tier 1 cancer risks (T1CRs) for carcinogenic effects. EPA (2002a) has indicated that exposure via inhalation should be evaluated separately from direct contact exposure because of the potential for qualitative and quantitative differences in effects via the different routes. However, in keeping with the conservatism of this screening assessment, risks/hazards associated with all exposure routes were summed.

A. Calculation of Tier 1 Cancer Risks

T1CRs for each receptor/route/pathway were calculated as the ratio of the representative concentration of a COPC in a given medium to the corresponding cancer Tier 1 screening level, multiplied by the target cancer risk level (10^{-6}):

$$\text{T1CR} = \frac{\text{Rep. Conc'n}}{\text{Tier 1 Screening Level}_{\text{cancer}}} \times \text{Target Risk Level} \qquad \{19\}$$

To account for simultaneous exposure to multiple carcinogens through a given exposure route (*e.g.*, ingestion of surface water), the risks calculated for each individual COPC encountered in a potential exposure medium via a given exposure route were summed to obtain a total risk for that medium/route.

For some potential exposure media, receptors could contact COPCs via more than one route (*e.g.*, incidental ingestion and dermal contact with surface water). To account for simultaneous exposure to multiple routes associated with the same exposure medium, individual route risks were summed to obtain a total exposure medium risk. Finally, to account for simultaneous exposure to multiple exposure media, total risks for each medium were summed to estimate a cumulative incremental cancer risk.

B. Calculation of Tier 1 Hazard Quotients and Indices

The degree of exceedance of the non-cancer target level of 1 was estimated by calculating the ratio of COPC representative concentration in an exposure medium to the corresponding non-cancer Tier 1 screening level. This ratio is termed a T1HQ:

$$\text{T1HQ} = \frac{\text{Rep. Conc'n}}{\text{Tier 1 Screening Level}_{\text{non-cancer}}} \qquad \{20\}$$

As with the carcinogenic evaluation, to account for simultaneous exposures, the T1HQs were summed as appropriate to produce a cumulative Tier 1 hazard index (T1HI) representing all potential exposures. The target level for the T1HI is also 1.

C. Risk Characterization Results

The risk characterization results for each receptor scenario are presented in Tables 23 through 28, discussed in the following sections.

1. On-Site Commercial/Industrial Worker

Estimated incremental lifetime cancer risks and non-cancer hazards to the On-Site Commercial/Industrial Worker scenario are summarized in Table 23. The cumulative T1CR was 4×10^{-6}, which is slightly above the EPA acceptable target risk value of 10^{-6} but well below the upper bound of EPA's target cancer risk range (10^{-4}). The fact that the representative concentration for arsenic of 7.93 mg/kg is less than the Illinois background concentration of 11.3 mg/kg indicates that this slight exceedance of the target risk level is insignificant.

The cumulative T1HI value was 0.2, one-fifth of the target level for non-cancer effects of 1. Iron, whose RfD is based upon the recommended daily allowance, contributed more than 40% of the T1HI.

These results indicate no unacceptable cancer risk or non-cancer hazard for this receptor population.

2. On-Site Construction Worker

Estimated incremental lifetime cancer risks and non-cancer hazards to the On-Site Construction Worker scenario are summarized in Table 24. The cumulative T1CR (8×10^{-8}) and T1HI (0.6) were both less than respective target levels. As with the Commercial/Industrial receptor, iron was the primary contributor to the T1HI, contributing more than 53%.

These results indicate no unacceptable cancer risk or non-cancer hazard for this receptor population.

3. Trespasser

Estimated incremental lifetime cancer risks and non-cancer hazards to the Trespasser scenario are summarized in Table 25. The cumulative T1CRs (1×10^{-7} and 1×10^{-7} to 2×10^{-7}) and T1HIs (both 0.05) calculated using withdrawn and proposed draft trichloroethylene toxicity criteria, respectively, were both well below respective target levels. Arsenic accounted for 100% of the cancer risk (via the incidental ingestion of sediment pathway), while iron was the major contributor to the T1HI.

Only two of the sediment samples collected at the Site, SD-WD-8 (450 mg/kg) and SD-WD-7 (2,700 mg/kg), had reported concentrations which exceeded the 400 mg/kg screening level for lead. These sampling locations are immediately off-Site to the south and southwest, respectively. As the 400 mg/kg screening value for residential exposure is based upon daily contact with soil, the fact that sediment levels exceed it in a few locations cannot be readily interpreted. While it is highly improbable that occasional contact with sediment-associated lead could result in adverse human health effects, the presence of these elevated levels indicates a need for further investigation.

These results indicate no unacceptable cancer risk or non-cancer hazard for this receptor population.

4. Off-Site Recreational Bather

Estimated incremental lifetime cancer risks and non-cancer hazards to the Off-Site Recreational Bather scenario are summarized in Table 26. The cumulative T1CRs (5×10^{-8} and 5×10^{-8} to 8×10^{-8}) and T1HIs (0.002 and 0.003) calculated using withdrawn and proposed draft trichloroethylene toxicity criteria, respectively, were both well below respective target levels. Arsenic accounted for 100% of the cancer risk (via the incidental ingestion of sediment pathway), while iron was the major contributor to the T1HI.

These results indicate no unacceptable cancer risk or non-cancer hazard for this receptor population.

5. Off-Site Resident

Estimated incremental lifetime cancer risks and non-cancer hazards to the Off-Site Resident are summarized in Table 27. The cumulative T1CR calculated using the withdrawn oral cancer slope factor for trichloroethylene was 7×10^{-8}, well below the target level of 10^{-6}. T1CRs calculated using the range of proposed draft slope factors for this compound were 1×10^{-7} and 3×10^{-6}, only slightly exceeding the target level of 10^{-6} when the upper bound slope factor is used. As none of the other relevant COPCs were carcinogenic, all potential cancer risk was contributed by trichloroethylene.

The cumulative T1HI of 0.1 was also less than the target level of 1. The major contributors to the T1HI were zinc (69%) and iron (19%). Use of the proposed draft reference dose for this compound resulted in a cumulative T1HI of 0.2.

These results indicate no unacceptable cancer risk or non-cancer hazard for this receptor population.

6. Off-Site Recreational Fisher

Estimated incremental lifetime cancer risks and non-cancer hazards to the Off-Site Recreational Fisher scenario are summarized in Table 28. The cumulative T1CRs (1×10^{-8} and 2×10^{-8} to 4×10^{-7}) and T1HI (both 0.9) calculated using withdrawn and proposed draft trichloroethylene toxicity criteria, respectively, were both below respective target levels. All potential cancer risk was contributed by trichloroethylene, and nearly all of the non-carcinogenic T1HI was due to zinc.

These results indicate no unacceptable cancer risk or non-cancer hazard for this receptor population.

D. Uncertainties Related to Tier 1 Risk Characterization

The Tier 1 risk characterization process combines exposure and toxicity information to develop an estimate of the Tier 1 cancer risks and non-cancer hazards that may be posed by COPCs to defined receptor populations. As discussed in previous sections, each of the assumptions and parameters involved in these operations has finite associated uncertainty, or variability, or both. Major sources of uncertainty in risk assessment parameters include (1) natural variability; (2) lack of knowledge about basic physical, chemical, and biological properties and processes; and (3) assumptions in the models used to approximate key inputs. Perhaps the greatest degree of uncertainty is associated with the toxicity criteria.

Although toxicity criteria are intentionally highly conservative and therefore likely to overestimate potential risks and hazards, the lack of criteria for several COPCs prevents their quantitative consideration and therefore may tend to underestimate potential risks associated with these compounds. However, as analytes lacking EPA-approved toxicity criteria were generally not known to be related to former Site operations, their omission is not considered to underestimate risk.

For screening purposes, underestimation of potential exposure and risk is avoided through use of upper-bound values for most parameters, including representative concentrations of COPCs, neglect of all conditions that mitigate exposure, such as soil/sediment sorption (*i.e.*, reduced bioavailability), and crude summing of all risks/hazards across all media. Thus, while this approach satisfies the requirement for protectiveness and affords a high degree of confidence that COPC concentrations lower than Tier 1 screening levels represent insignificant risk, it provides (1) no insight into the sources and magnitude of underlying uncertainties, (2) no indication of where calculated risks may fall in the distribution of actual risks, and (3) no context for interpretation of results that exceed the conservative Tier 1 criteria. As a result, the results of the Tier 1 risk characterization can be effectively used to eliminate source areas/pathways from further consideration where total T1CRs and T1HI are below target risk and hazard levels, but they cannot be used to draw conclusions about the existence of unacceptable risk where these targets are exceeded.

As indicated in Section IV, the risk and hazards calculated for trichloroethylene were based on both the withdrawn and proposed draft toxicity values presented in Table 15. Use of the proposed draft oral cancer slope factor range resulted in a 2- to 36-fold increase in estimated carcinogenic risk. Use of the proposed draft oral reference dose resulted in a 20-fold increase in non-carcinogenic hazard. As discussed in Section VI.C.5, the only receptor whose potential Tier 1 cancer risk level slightly exceeds the target level of 10^{-6} on account of using the proposed draft slope factor range is the off-Site Resident, and only when the upper bound of the range is used (0.4 per mg/kg-day). Since the surface water concentration, 0.00039 mg/L, used in the estimation of this risk is the detection limit of trichloroethylene and the sampling point used is from the stream as it moves off the east side of the property rather than the actual exposure point (Lake Hillsboro), which is seldom drawn upon for potable use, this slight exceedance is not considered indicative of unacceptable risk.

VII. SUMMARY AND CONCLUSIONS

The purpose of this Tier 1 HHRA was to quantitatively evaluate potential current and future human health risks associated with the Site under continued commercial/ industrial land use conditions. COPC-, pathway-, and medium-specific Tier 1 screening levels for carcinogenic and non-carcinogenic effects were calculated for each of six receptor populations using algorithms from EPA guidance parameterized with conservative default exposure parameter values and EPA-approved toxicity criteria. As a result, the cumulative T1CRs/T1HIs for the defined receptor populations are likely to significantly exaggerate potential risks/hazards.

Despite the uniformly conservative assumptions made in this HHRA, the results indicated that with one exception, all cumulative T1HIs are below the target level of 1, indicating little, if any, potential for adverse non-cancer health effects associated with the Site. Two sediment samples collected immediately south and southwest of the Site boundary contained levels of lead in excess of the highly conservative screening level (400 mg/kg), which is based on daily exposure of a young child to soil rather than occasional contact with aquatic sediment. Because the area of affected sediment is very limited and the screening level is based on a much more intensive exposure regime than could occur by occasional contact with sediment, the fact that the representative sediment concentration is exceeded cannot be interpreted as indicating risk. However, the fact that lead levels are elevated in this area may warrant further evaluation.

The only T1CRs greater than the target level of 10^{-6} were (1) 4×10^{-6} computed for the On-Site Commercial/Industrial Worker, due entirely to potential exposure to arsenic in surface soil, and (2) 3×10^{-6} computed for the off-Site Resident due to potential exposure to trichloroethylene in potable water from Lake Hillsboro when the upper bound of the proposed draft slope factor range is used. The representative concentration of arsenic (7.9 mg/kg) is below the Illinois background level (11.3 mg/kg), and arsenic was not used as a raw material and was not a product of Site operations. The detection-level value used as the representative concentration of trichloroethylene in Lake Hillsboro was obtained from a sampling location close to the Site, and as such does not represent conditions in Lake Hillsboro. Further, as discussed in Section III, this water is seldom used for potable purposes. Thus, these slight exceedances of the lower bound of EPA's target cancer risk range are not interpreted as suggestive of an unacceptable risk to human health.

Because none of the cumulative T1CRs/T1HI exceeded target levels for either carcinogenic or non-carcinogenic effects, the results of this HHRA support the conclusion that under current and reasonably anticipated future conditions, COPCs at the

Site pose no significant cancer risk or non-carcinogenic hazard to the six receptor populations considered in the HHRA. This conclusion comports with that reached by the Illinois Department of Public Health (IDPH) in its recent health consultation for this Site (IDPH 2002).

VIII. REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR), 1997. *Draft Toxicological Profile for Lead.* Lewis Publishers, Boca Raton, Florida.

Beyer, W.N. 1986. A reexamination of biomagnification of metals in terrestrial food chains. *Environ Toxicol Chem* **5**:863–864.

Cowherd, C.G., G. Muleski, P. Engelhart, and D. Gillette. 1985. *Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites*. U.S. EPA, Office of Health and Environmental Assessment, Washington, D.C. EPA/600/8-85/002.

ENVIRON International Corporation. 2002a. Preliminary Site Evaluation Report. Remedial Investigation/ Feasibility Study for the Eagle Zinc Company Site, Hillsboro, Illinois. March 2002.

___. 2002b. Remedial Investigation/Feasibility Study Work Plan. Remedial Investigation/ Feasibility Study for the Eagle Zinc Company Site, Hillsboro, Illinois. July 2002.

___. 2003a. Technical Memorandum. Remedial Investigation Phase 1: Source Characterization. Remedial Investigation/Feasibility Study for the Eagle Zinc Company Site, Hillsboro, Illinois. March 2003.

___. 2003b. Technical Memorandum. Remedial Investigation Phase 2: Migration Pathway Assessment. Remedial Investigation/Feasibility Study for the Eagle Zinc Company Site, Hillsboro, Illinois. November 2003.

ENVIRON. 2004. Ecological Risk Assessment Screening Evaluation. Remedial Investigation/Feasibility Study, Eagle Zinc Company Site, Hillsboro, Illinois. August 2004.

Illinois Department of Public Health (IDPH). 2002. Health Consultation, Eagle Zinc Company, Division of T.L. Diamond, Hillsboro, Montgomery County, Illinois. http://www.atsdr.cdc.gov/HAC/PHA/eaglezinc/ezc_p1.html#F1.

Suedel, B.C., Boraczek, J.A., Peddicord, R.K., Clifford, P.A., and Dillon, T.M. 1994. Trophic transfer and biomagnification potential of contaminants in aquatic ecosystems. *Rev Environ Contam Toxicol* **136**:21–89.

Texas Commission on Environmental Quality (TCEQ). 2003. Texas Risk Reduction Program. Chemical Properties Table for the Development of Protective Concentration Levels. Last updated March 31, 2003.

U.S. Environmental Protection Agency (EPA). 1986. *Guidelines for Carcinogen Risk Assessment.* Federal Register 51:33992-34003.

___. 1989. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A). EPA/540/1-89/002. Office of Emergency and Remedial Response, Washington, D.C. December 1989.

___. 1991a. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals). EPA/540/R-92/003. Office of Emergency and Remedial Response, Washington, D.C. December 1991.

___. 1991b. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. OSWER Directive 9355.0-30. April 22, 1991.

___. 1992. Supplemental Guidance to RAGS: Calculating the Concentration Term. Publication PB92-963373. Office of Solid Waste and Emergency Response, Washington, DC. May 1992.

___. 1994a. Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children. (IEUBK) Office of Research and Development, Washington, D.C. EPA/540/R-93/081.

___. 1994b. Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. OSWER Directive #9355.4-12. Office of Solid Waste and Emergency Response, Washington, D.C.

___. 1996. *Soil Screening Guidance: Technical Background Document*, EPA/540/R95/128, Office of Emergency and Remedial Response, Washington, D. C. May 1996.

___. 1997a. Exposure Factors Handbook Volume I – General Factors. EPA/600/P-95/002Fa. Office of Research and Development, Washington, DC. August 1997

___. 1997b. Exposure Factors Handbook Volume II – Food Ingestion Factors. EPA/600/P-95/002Fa. Office of Research and Development, Washington, DC. August 1997.

___. 1997c. Exposure Factors Handbook Volume III – Activity Factors. EPA/600/P-95/002Fa. Office of Research and Development, Washington, DC. August 1997.

___. 1997d. Health Effects Assessment Summary Tables (HEAST), Office of Solid Waste and Emergency Response.

___. 2001a. *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).* Interim. Review Draft – For Public Comment. EPA/540/R/99/005. Office of Emergency and Remedial Response, Washington, D.C. September 2001.

___. 2001b. *Trichloroethylene Health Risk Assessment: Synthesis and Characterization.* EPA/600/P-01/002A. Office of Research and Development, Washington, D.C. August 2001.

___. 2002a. *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.* OSWER 9355.4-24, Office of Emergency and Remedial Response, Washington, D. C.

___. 2002b. *Child-Specific Exposure Factors Handbook.* National Center for Environmental Assessment – Washington Office, Office of Research and Development, Washington, D.C. September 2002 Interim Report, EPA-600-P-00-002B.

___. 2002c. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December 2002.

___. 2003a. *Draft Final Guidelines for Carcinogen Risk Assessment.* EPA/530/P-03/001A. NCEA-F-0644A. Draft final.

___. 2003b. Human Health Toxicity Values in Superfund Risk Assessments. OSWER Directive 9285.7-53.

___. 2003c. National Primary Drinking Water Standards. Office of Water. EPA 816-F-03-016.

___. 2004a. Guidance for Preparing Superfund Ready for Reuse Determinations (OSWER 9365.0-33).

___. 2004b. Integrated Risk Information System (IRIS) Database. Office of Research and Development, National Center for Environmental Assessment. Website: www.epa.gov/iris.

___ Region 3. 1993. Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening. U.S. EPA Region III Technical Guidance Manual. EPA/903/R-93-001. January 1993.

___ Region 3. 2003a. Risk-Based Concentration Tables, October 2003 update. (http://www.epa.gov/reg3hwmd/risk/human/index.htm).

___ Region 3. 2003b. Technical Background Information for Risk-Based Concentrations. Updated 4/16/2003. (http://www.epa.gov/reg3hwmd/risk/human/info/tech.htm).

___ Region 9. 2002. Region 9 PRGs Table 2002 Update. October 1, 2002. (http://www.epa.gov/region09/waste/sfund/prg/files/02userguide.pdf)

World Health Organization (WHO). 2001. *Zinc.* Environmental Health Criteria 221. (http://www.inchem.org/documents/ehc/ehc/ehc167.htm).

TABLES

TABLES

Table 1. Summary of Potentially Complete Exposure Pathways to be Considered in the HHRA for the Eagle Zinc Company Site

Receptor Scenario	Potential Exposure Medium	Potential Exposure Route	Pathway Considered Complete?	Rationale/Comment
On-Site Resident	Ground Water	Potable use	No	Historical use and zoning of the Site is industrial, and plans exist for future commercial/industrial re-use Therefore, residential development is not a reasonably anticipated future land use
	Surface soil Subsurface soil	Vapor inhalation Particle inhalation Ingestion Dermal contact		
On-Site Industrial Worker	Ground Water	Potable use	No	Site ground water is not a current or potential source of potable water Potable water in these areas is supplied by the city Further, the low yield of the affected aquifer makes its development as a water source unlikely
	Surface soil	Vapor inhalation Particle inhalation Ingestion Dermal contact	Yes	Workers could come into contact with surface soil. Accordingly, exposure via ingestion, inhalation, and dermal contact will be evaluated
	Subsurface soil	Vapor inhalation Particle inhalation Ingestion Dermal contact	Yes	Although workers would not contact subsurface soil under current conditions, it is possible that they could contact excavated material in the future Because the representative concentrations of COPCs in on-Site soil include both surface and subsurface samples, potential contact with subsurface material is accounted for
On-Site Construction Worker	Ground Water	Potable use	No	Site ground water is not a current or potential source of potable water Potable water in these areas is supplied by the city Further, the low yield of the affected aquifer makes its development as a water source unlikely
		Dermal contact	Yes	Construction workers could contact ground water while excavating
	Surface soil Subsurface soil	Vapor inhalation Particle inhalation Ingestion Dermal contact	Yes	Construction workers could contact surface and subsurface soil during excavation and building activities Accordingly, exposure via ingestion, inhalation, and dermal contact will be evaluated
Trespasser	Ground Water	Potable use	No	Site ground water is not a current or potential source of potable water Potable water in these areas is supplied by the city Further, the low yield of the affected aquifer makes its development as a water source unlikely
	Subsurface soil	Vapor inhalation Particle inhalation Ingestion Dermal contact	No	Trespassers would not contact subsurface soil under reasonably foreseeable conditions
	Surface soil	Vapor inhalation Particle inhalation Ingestion Dermal contact	Yes	Trespassers could come into contact with surface soil. Accordingly, exposure via ingestion, inhalation, and dermal contact will be evaluated
	Southwest pond surface water	Ingestion Dermal contact	Yes	Surface water runoff as well as site ground water could flow into the southwestern pond, which could attract trespassers Therefore, swimming contact with COPCs in surface water and sediment will be considered in the risk assessment
	Sediment	Ingestion	Yes	
		Dermal contact	No	Exposure to COPCs via dermal contact with sediment is considered to be negligible

Receptor Scenario	Potential Exposure Medium	Potential Exposure Route	Pathway Considered Complete?	Rationale/Comment
Off-Site Resident	Ground Water	Potable use	No	Site ground water is not a current or potential source of potable water Potable water in these areas is supplied by the city Further, the low yield of the affected aquifer makes its development as a water source unlikely
	Surface soil	Particle inhalation Ingestion Dermal contact	No	Soil investigations conducted by IEPA indicated no evidence of off-Site migration of affected surface soil Therefore, this potential exposure pathway is not complete
	Lake Hillsboro surface water	Potable use	Yes	Lake Hillsboro is used as a backup drinking water source for the City of Hillsboro (primary source is Lake Glenn Shoals) Although the intake is distant from the point of confluence with water bodies affected by the Site, this potential pathway has been evaluated to ensure that drinking water quality is not impacted
Off-Site Recreational Bather	Lake Hillsboro surface water	Ingestion Dermal contact	Yes	Surface water runoff from the Site empties into an unnamed tributary of Mid Fork Shoal Creek to the southwest, and into an unnamed tributary to Lake Hillsboro to the east. Recreational users wading and swimming in Lake Hillsboro could be exposed to chemicals present in surface water and sediment.
	Lake Hillsboro sediment	Ingestion	Yes	
		Dermal contact	No	Exposure to COPCs via dermal contact with sediment is considered to be negligible
Off-Site Fisher	Fish in Lake Hillsboro	Ingestion	Yes	Regular consumption of fish from Lake Hillsboro is a possible exposure pathway

Table 2. Region 3 Risk-Based Concentrations and Illinois Background Concentrations of Analytes

Compound	CAS	Residential Soil[a] mg/kg	Illinois Background[b] mg/kg	TapWater[a] µg/liter
Aluminum	7429-90-5	78000	9200	37000
Antimony	7440-36-0	31	3.3	15
Arsenic	7440-38-2	0.43	11.3	0.05
Barium	7440-39-3	5500	122	2600
Beryllium	7440-41-7	160	0.56	73
Cadmium	7440-43-9	78	0.5	37
Chromium	16065-83-1	230	.	110
Cobalt	7440-48-4	1600	8.9	730
Copper	7440-50-8	3100	12	1500
Iron	7439-89-6	23000	15000	11000
Lead[c]	7439-92-1	400	20.9	15
Manganese	7439-96-5	1600	630	730
Mercury	7439-97-6/	23	.	11
Nickel	7440-02-0	1600	.	730
Selenium	7782-49-2	390	.	180
Silver	7440-22-4	390	.	180
Thallium	7791-12-0	6.3	.	2.9
Vanadium	7440-62-2	23	.	11
Zinc	7440-66-6	23000	.	11000
Calcium	7440-70-2	1000000	5525	.
Magnesium	7439-95-4	420000	2700	.
Potassium	7440-09-7	1000000	.	.
Sodium	7440-23-5	1000000	.	.
Aroclor 1016	12674-11-2	5.5	.	0.96
Aroclor 1221	11104-28-2	0.32	.	0.03
Aroclor 1232	11141-16-5	0.32	.	0.03
Aroclor 1242	53469-21-9	0.32	.	0.03
Aroclor 1248	12672-29-6	0.32	.	0.03
Aroclor 1254	11097-69-1	0.32	.	0.03
Aroclor 1260	11096-82-5	0.32	.	0.03
2,2'-oxybis(1-Chloropropane)	108-60-1	9.1	.	0.26
2,4,5-Trichlorophenol	95-95-4	7800	.	3700
2,4,6-Trichlorophenol	88-06-2	58	.	6.1
2,4-Dichlorophenol	120-83-2	230	.	110
2,4-Dimethylphenol	105-67-9	1600	.	730
2,4-Dinitrophenol	51-28-5	160	.	73
2,4-Dinitrotoluene	121-14-2	160	.	73
2,6-Dinitrotoluene	606-20-2	78	.	37
2-Chloronaphthalene	91-58-7	6300	.	490
2-Chlorophenol	95-57-8	390	.	30
2-Methylnaphthalene	91-57-6	1600	.	120
2-Methylphenol	95-48-7	3900	.	1800
2-Nitroaniline	88-74-4	230	.	110
2-Nitrophenol	88-75-5	160	.	15
3,3-Dichlorobenzidine	91-94-1	1.4	.	0.15
3-Nitroaniline	99-09-2	23	.	3.3
4,6-Dinitro-2-methylphenol	534-52-1	7.8	.	3.7

Table 2. Region 3 Risk-Based Concentrations and Illinois Background Concentrations of Analytes

Compound	CAS	Residential Soil[a] mg/kg	Illinois Background[b] mg/kg	TapWater[a] µg/liter
4-Bromophenyl phenyl ether	101-55-3	0.04	.	0
4-Chloro-3-methylphenol	59-50-7	390	.	37
4-Chloroaniline	106-47-8	310	.	150
4-Chlorophenyl phenyl ether	7005-72-3	0.04	.	0
4-Methylphenol	106-44-5	390	.	180
4-Nitroaniline	100-01-6	32	.	3.3
4-Nitrophenol	100-02-7	160	.	150
Acenaphthylene	208-96-8	4700	.	370
Acetophenone	98-86-2	7800	.	610
Anthracene	120-12-7	23000	.	1800
Atrazine	1912-24-9	2.9	.	0.3
Benzaldehyde	100-52-7	7800	.	3700
Benzo(a)anthracene	56-55-3	0.87	.	0.09
Benzo(a)pyrene	50-32-8	0.09	.	0.01
Benzo(b)fluoranthene	205-99-2	0.87	.	0.09
Benzo(k)fluoranthene	207-08-9	8.7	.	0.92
Biphenyl	92-52-4	3900	.	300
Butylbenzylphthalate	85-68-7	16000	.	7300
Caprolactam	105-60-2	39000	.	18000
Carbazole	86-74-8	32	.	3.3
Chrysene	218-01-9	87	.	9.2
Di-n-butylphthalate	84-74-2	7800	.	3700
Di-n-octylphthalate	117-84-0	3100	.	1500
Dibenzo(a,h)anthracene	53-70-3	0.09	.	0.01
Dibenzofuran	132-64-9	160	.	12
Diethylphthalate	84-66-2	63000	.	29000
Dimethylphthalate	131-11-3	780000	.	370000
Fluoranthene	206-44-0	3100	.	1500
Fluorene	86-73-7	3100	.	240
Hexachlorobenzene	118-74-1	0.4	.	0.04
Hexachlorobutadiene	87-68-3	8.2	.	0.86
Hexachlorocyclopentadiene	77-47-4	470	.	220
Hexachloroethane	67-72-1	46	.	4.8
Indeno(1,2,3-cd)pyrene	193-39-5	0.87	.	0.09
Isophorone	78-59-1	670	.	70
N-Nitroso-di-n-propylamine	621-64-7	0.09	.	0.01
N-Nitrosodiphenylamine	86-30-6	130	.	14
Naphthalene	91-20-3	1600	.	6.5
Nitrobenzene	98-95-3	39	.	3.5
Pentachlorophenol	87-86-5	5.3	.	0.56
Phenol	108-95-2	23000	.	11000
Pyrene	129-00-0	2300	.	180
bis(2-Chloroethoxy)methane	111-91-1	0.58	.	0.01
bis(2-Chloroethyl)ether	111-44-4	0.58	.	0.01
bis(2-Ethylhexyl)phthalate	117-81-7	46	.	4.8
1,1,1-Trichloroethane	71-55-6	22000	.	3200
1,1,2,2-Tetrachloroethane	79-34-5	3.2	.	0.05

Table 2. Region 3 Risk-Based Concentrations and Illinois Background Concentrations of Analytes

Compound	CAS	Residential Soil[a] mg/kg	Illinois Background[b] mg/kg	TapWater[a] µg/liter
1,1,2-Trichloroethane	79-00-5	11	.	0.19
1,1,2-Trichlorotrifluoroethane	76-13-1	2300000	.	59000
1,1-Dichloroethane	75-34-3	7800	.	800
1,1-Dichloroethene	75-35-4	3900	.	350
1,2,4-Trichlorobenzene	120-82-1	780	.	7.2
1,2-Dibromo-3-chloropropane	96-12-8	0.46	.	0.05
1,2-Dibromoethane	106-93-4	0.01	.	0
1,2-Dichlorobenzene	95-50-1	7000	.	270
1,2-Dichloroethane	107-06-2	7	.	0.12
1,2-Dichloropropane	78-87-5	9.4	.	0.16
1,3-Dichlorobenzene	541-73-1	2300	.	180
1,4-Dichlorobenzene	106-46-7	27	.	0.47
2-Butanone	78-93-3	47000	.	7000
2-Hexanone	591-78-6	4700	.	440
4-Methyl-2-pentanone	108-10-1	6300	.	580
Acetone	67-64-1	70000	.	5500
Benzene	71-43-2	12	.	0.34
Bromodichloromethane	75-27-4	10	.	0.17
Bromoform	75-25-2	81	.	8.5
Bromomethane	74-83-9	110	.	8.5
Carbon Disulfide	75-15-0	7800	.	1000
Carbon Tetrachloride	56-23-5	4.9	.	0.16
Chlorobenzene	108-90-7	1600	.	110
Chlorodibromomethane	124-48-1	7.6	.	0.13
Chloroethane	75-00-3	220	.	3.6
Chloroform	67-66-3	780	.	0.15
Chloromethane	74-87-3	49	.	0.8
Cyclohexane	110-82-7	390000	.	36500
Dichlorodifluoromethane	75-71-8	16000	.	350
Ethylbenzene	100-41-4	7800	.	1300
Fluorotrichloromethane	75-69-4	23000	.	1300
Isopropylbenzene	98-82-8	7800	.	660
Methyl Acetate	79-20-9	78000	.	6100
Methyl-tert-butyl-ether	1634-04-4	160	.	2.6
Methylcyclohexane	108-87-2	390000	.	36500
Methylene Chloride	75-09-2	85	.	4.1
Styrene	100-42-5	16000	.	1600
Tetrachloroethene	127-18-4	1.2	.	0.1
Toluene	108-88-3	16000	.	750
Trichloroethylene	79-01-6	1.6	.	0.03
Vinyl Chloride	75-01-4	0.09	.	0.02
Xylenes, m + p	108-38-3	16000	.	210
cis-1,2-Dichloroethene	156-59-2	780	.	61
trans-1,2-Dichloroethene	156-60-5	1600	.	120
trans-1,3-Dichloropropene	10061-02-6	6.4	.	0.44

[a] - Data obtained from http://www.epa.gov/reg3hwmd/risk/human/index.htm, representative values for appropriate surrogates, were calucated as described in the document.

Table 2. Region 3 Risk-Based Concentrations and Illinois Background Concentrations of Analytes

Compound	CAS	Residential Soil[a] mg/kg	Illinois Background[b] mg/kg	TapWater[a] μg/liter

[b] - as specified in Table G of Appendix A of 35 Illinois Administrative Code 742.

[c] - values for lead in soil obtained from EPA (2002b) and MCL from EPA 2004.

Table 3
Summary of COPC Selection Process
SOIL (Units mg/kg)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
Calcium	7440-70-2	28	28	0	100%	530	36000			1,000,000	RDA			Det. Freq > 5% but RBC not exceeded
Magnesium	7439-95-4	28	28	0	100%	1300	22000			420,000	RDA			Det. Freq > 5% but RBC not exceeded
Potassium	7440-09-7	28	28	0	100%	690	2600			1,000,000	RDA			Det. Freq > 5% but RBC not exceeded
Sodium	7440-23-5	28	17	11	61%	39	390	10	41.5	1,000,000	RDA			Det. Freq > 5% but RBC not exceeded
Aluminum	7429-90-5	28	28	0	100%	8300	33000			78,000	ResSoil			Det. Freq > 5% but RBC not exceeded
Antimony	7440-36-0	28	14	14	50%	0.34	1.9	0.165	1	31	ResSoil			Det. Freq > 5% but RBC not exceeded
Arsenic	7440-38-2	28	28	0	100%	1.9	13			11.3	BackGrd	Yes		Det. Freq > 5% and exceeds RBC
Barium	7440-39-3	28	28	0	100%	46	490			5,500	ResSoil			Det. Freq > 5% but RBC not exceeded
Beryllium	7440-41-7	28	28	0	100%	0.61	2.8			160	ResSoil			Det. Freq > 5% but RBC not exceeded
Cadmium	7440-43-9	28	28	0	100%	0.12	87			78	ResSoil	Yes		Det. Freq > 5% and exceeds RBC
Chromium	16065-83-1	28	28	0	100%	12	38			230	ResSoil			Det. Freq > 5% but RBC not exceeded
Cobalt	7440-48-4	28	28	0	100%	2.1	29			1,600	ResSoil			Det. Freq > 5% but RBC not exceeded
Copper	7440-50-8	28	28	0	100%	9.1	35			3,100	ResSoil			Det. Freq > 5% but RBC not exceeded
Iron	7439-89-6	28	28	0	100%	9100	47000			23,000	ResSoil	Yes		Det. Freq > 5% and exceeds RBC
Lead	7439-92-1	28	28	0	100%	7.4	100			400	ResSoil			Det. Freq > 5% but RBC not exceeded
Manganese	7439-96-5	28	28	0	100%	38	1900			1,600	ResSoil	Yes		Det. Freq > 5% and exceeds RBC
Mercury	7439-97-6/	28	25	3	89%	0.0064	0.27	0.00235	0.00255	23	ResSoil			Det. Freq > 5% but RBC not exceeded
Nickel	7440-02-0	28	28	0	100%	8.6	93			1,600	ResSoil			Det. Freq > 5% but RBC not exceeded
Selenium	7782-49-2	28	2	26	7%	1.7	1.7	0.135	0.9	390	ResSoil			Det. Freq > 5% but RBC not exceeded
Silver	7440-22-4	28	2	26	7%	0.094	0.42	0.0335	0.2	390	ResSoil			Det. Freq > 5% but RBC not exceeded
Thallium	7791-12-0	28	16	12	57%	0.41	2.1	0.18	1.05	6.3	ResSoil			Det. Freq > 5% but RBC not exceeded
Vanadium	7440-62-2	28	28	0	100%	16	72			23	ResSoil	Yes		Det. Freq > 5% and exceeds RBC
Zinc	7440-66-6	28	28	0	100%	50	11000			23,000	ResSoil			Det. Freq > 5% but RBC not exceeded
Aroclor 1016	12674-11-2	15	0	15				0.008	0.01	5.5	ResSoil			Not detected and not greater than RBC
Aroclor 1221	11104-28-2	15	0	15				0.008	0.01	0.32	ResSoil			Not detected and not greater than RBC
Aroclor 1232	11141-16-5	15	0	15				0.008	0.01	0.32	ResSoil			Not detected and not greater than RBC
Aroclor 1242	53469-21-9	15	0	15				0.008	0.01	0.32	ResSoil			Not detected and not greater than RBC
Aroclor 1248	12672-29-6	15	0	15				0.008	0.01	0.32	ResSoil			Not detected and not greater than RBC
Aroclor 1254	11097-69-1	15	0	15				0.008	0.01	0.32	ResSoil			Not detected and not greater than RBC
Aroclor 1260	11096-82-5	15	0	15				0.008	0.01	0.32	ResSoil			Not detected and not greater than RBC
2,2'-oxybis(1-Chloropropane)	108-60-1	16	0	16				0.0325	0.05	9.1	ResSoil			Not detected and not greater than RBC
2,4,5-Trichlorophenol	95-95-4	16	0	16				0.045	0.07	7,800	ResSoil			Not detected and not greater than RBC
2,4,6-Trichlorophenol	88-06-2	16	0	16				0.03	0.0465	58	ResSoil			Not detected and not greater than RBC
2,4-Dichlorophenol	120-83-2	16	0	16				0.045	0.07	230	ResSoil			Not detected and not greater than RBC
2,4-Dimethylphenol	105-67-9	16	0	16				0.065	0.1	1,600	ResSoil			Not detected and not greater than RBC
2,4-Dinitrophenol	51-28-5	16	0	16				0.065	0.095	160	ResSoil			Not detected and not greater than RBC
2,4-Dinitrotoluene	121-14-2	16	0	16				0.07	0.105	160	ResSoil			Not detected and not greater than RBC
2,6-Dinitrotoluene	606-20-2	16	0	16				0.04	0.06	78	ResSoil			Not detected and not greater than RBC
2-Chloronaphthalene	91-58-7	16	0	16				0.035	0.055	6,300	ResSoil			Not detected and not greater than RBC

Table 3
Summary of COPC Selection Process
SOIL (Units mg/kg)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
2-Chlorophenol	95-57-8	16	0	16				0.04	0.06	390	ResSoil			Not detected and not greater than RBC
2-Methylnaphthalene	91-57-6	16	0	16				0.04	0.06	1,600	ResSoil			Not detected and not greater than RBC
2-Methylphenol	95-48-7	16	0	16				0.045	0.07	3,900	ResSoil			Not detected and not greater than RBC
2-Nitroaniline	88-74-4	16	0	16				0.065	0.1	230	ResSoil			Not detected and not greater than RBC
2-Nitrophenol	88-75-5	16	0	16				0.0375	0.06	160	ResSoil			Not detected and not greater than RBC
3,3-Dichlorobenzidine	91-94-1	16	0	16				0.065	0.1	1.4	ResSoil			Not detected and not greater than RBC
3-Nitroaniline	99-09-2	16	0	16				0.025	0.0385	23	ResSoil			Not detected and not greater than RBC
4,6-Dinitro-2-methylphenol	534-52-1	16	0	16				0.055	0.08	7.8	ResSoil			Not detected and not greater than RBC
4-Bromophenyl phenyl ether	*101-55-3*	*16*	*0*	*16*				*0.03*	*0.0465*	*0.043*	*ResSoil*		*Yes*	*Not detected but greater than RBC*
4-Chloro-3-methylphenol	59-50-7	16	0	16				0.055	0.08	390	ResSoil			Not detected and not greater than RBC
4-Chloroaniline	106-47-8	16	0	16				0.03	0.0465	310	ResSoil			Not detected and not greater than RBC
4-Chlorophenyl phenyl ether	*7005-72-3*	*16*	*0*	*16*				*0.045*	*0.07*	*0.043*	*ResSoil*		*Yes*	*Not detected but greater than RBC*
4-Methylphenol	106-44-5	16	0	16				0.04	0.06	390	ResSoil			Not detected and not greater than RBC
4-Nitroaniline	100-01-6	16	0	16				0.12	0.185	32	ResSoil			Not detected and not greater than RBC
4-Nitrophenol	100-02-7	16	0	16				0.12	0.18	160	ResSoil			Not detected and not greater than RBC
Acenaphthylene	208-96-8	32	0	32				0.0375	0.065	4,700	ResSoil			Not detected and not greater than RBC
Acetophenone	98-86-2	16	0	16				0.045	0.07	7,800	ResSoil			Not detected and not greater than RBC
Anthracene	120-12-7	16	0	16				0.0325	0.05	23,000	ResSoil			Not detected and not greater than RBC
Atrazine	1912-24-9	16	0	16				0.03	0.0465	2.9	ResSoil			Not detected and not greater than RBC
Benzaldehyde	100-52-7	16	0	16				0.035	0.055	7,800	ResSoil			Not detected and not greater than RBC
Benzo(a)anthracene	56-55-3	16	0	16				0.045	0.07	0.87	ResSoil			Not detected and not greater than RBC
Benzo(a)pyrene	50-32-8	16	0	16				0.0375	0.06	0.087	ResSoil			Not detected and not greater than RBC
Benzo(b)fluoranthene	205-99-2	16	0	16				0.06	0.095	0.87	ResSoil			Not detected and not greater than RBC
Benzo(k)fluoranthene	207-08-9	16	0	16				0.05	0.075	8.7	ResSoil			Not detected and not greater than RBC
Biphenyl	92-52-4	16	0	16				0.04	0.06	3,900	ResSoil			Not detected and not greater than RBC
Butylbenzylphthalate	85-68-7	16	0	16				0.04	0.06	16,000	ResSoil			Not detected and not greater than RBC
Caprolactam	105-60-2	16	0	16				0.0375	0.06	39,000	ResSoil			Not detected and not greater than RBC
Carbazole	86-74-8	16	0	16				0.08	0.12	32	ResSoil			Not detected and not greater than RBC
Chrysene	218-01-9	16	0	16				0.055	0.08	87	ResSoil			Not detected and not greater than RBC
Di-n-butylphthalate	84-74-2	16	0	16				0.04	0.06	7,800	ResSoil			Not detected and not greater than RBC
Di-n-octylphthalate	117-84-0	16	0	16				0.055	0.08	3,100	ResSoil			Not detected and not greater than RBC
Dibenzo(a,h)anthracene	53-70-3	16	0	16				0.03	0.0465	0.087	ResSoil			Not detected and not greater than RBC
Dibenzofuran	132-64-9	16	0	16				0.05	0.075	160	ResSoil			Not detected and not greater than RBC
Diethylphthalate	84-66-2	16	0	16				0.05	0.075	63,000	ResSoil			Not detected and not greater than RBC
Dimethylphthalate	131-11-3	16	0	16				0.045	0.07	780,000	ResSoil			Not detected and not greater than RBC
Fluoranthene	206-44-0	16	0	16				0.055	0.09	3,100	ResSoil			Not detected and not greater than RBC
Fluorene	86-73-7	16	0	16				0.05	0.075	3,100	ResSoil			Not detected and not greater than RBC
Hexachlorobenzene	118-74-1	16	0	16				0.025	0.0385	0.4	ResSoil			Not detected and not greater than RBC

Table 3
Summary of COPC Selection Process
SOIL (Units mg/kg)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples #	DT	ND	Frequency of Detection	Detected Concentration Min	Max	Detection Limits Min	Max	Comparison RBC Value	Note[a]	COPC[b]	Address in Uncertainty	Rationale
Hexachlorobutadiene	87-68-3	16	0	16				0.045	0.07	8.2	ResSoil			Not detected and not greater than RBC
Hexachlorocyclopentadiene	77-47-4	16	0	16				0.03	0.0465	470	ResSoil			Not detected and not greater than RBC
Hexachloroethane	67-72-1	16	0	16				0.0425	0.065	46	ResSoil			Not detected and not greater than RBC
Indeno(1,2,3-cd)pyrene	193-39-5	16	0	16				0.0375	0.06	0.87	ResSoil			Not detected and not greater than RBC
Isophorone	78-59-1	16	0	16				0.03	0.0465	670	ResSoil			Not detected and not greater than RBC
N-Nitroso-di-n-propylamine	621-64-7	16	0	16				0.0325	0.05	0.091	ResSoil			Not detected and not greater than RBC
N-Nitrosodiphenylamine	86-30-6	16	0	16				0.0425	0.065	130	ResSoil			Not detected and not greater than RBC
Naphthalene	91-20-3	16	0	16				0.0425	0.065	1,600	ResSoil			Not detected and not greater than RBC
Nitrobenzene	98-95-3	16	0	16				0.0425	0.065	39	ResSoil			Not detected and not greater than RBC
Pentachlorophenol	87-86-5	16	0	16				0.055	0.08	5.3	ResSoil			Not detected and not greater than RBC
Phenol	108-95-2	16	0	16				0.03	0.0465	23,000	ResSoil			Not detected and not greater than RBC
Pyrene	129-00-0	48	0	48				0.0325	0.09	2,300	ResSoil			Not detected and not greater than RBC
bis(2-Chloroethoxy)methane	111-91-1	16	0	16				0.0375	0.06	0.58	ResSoil			Not detected and not greater than RBC
bis(2-Chloroethyl)ether	111-44-4	16	0	16				0.035	0.055	0.58	ResSoil			Not detected and not greater than RBC
bis(2-Ethylhexyl)phthalate	117-81-7	16	0	16				0.04	0.06	46	ResSoil			Not detected and not greater than RBC
1,1,1-Trichloroethane	71-55-6	18	0	18				0.000405	0.001	22,000	ResSoil			Not detected and not greater than RBC
1,1,2,2-Tetrachloroethane	79-34-5	18	0	18				0.000435	0.00105	3.2	ResSoil			Not detected and not greater than RBC
1,1,2-Trichloroethane	79-00-5	18	0	18				0.000365	0.0009	11	ResSoil			Not detected and not greater than RBC
1,1,2-Trichlorotrifluoroethane	76-13-1	18	0	18				0.0005	0.0012	2,300,000	ResSoil			Not detected and not greater than RBC
1,1-Dichloroethane	75-34-3	18	0	18				0.00043	0.00105	7,800	ResSoil			Not detected and not greater than RBC
1,1-Dichloroethene	75-35-4	18	0	18				0.0005	0.0012	3,900	ResSoil			Not detected and not greater than RBC
1,2,4-Trichlorobenzene	120-82-1	34	0	34				0.00044	0.07	780	ResSoil			Not detected and not greater than RBC
1,2-Dibromo-3-chloropropane	96-12-8	18	0	18				0.0005	0.0012	0.46	ResSoil			Not detected and not greater than RBC
1,2-Dibromoethane	106-93-4	18	0	18				0.00037	0.0009	0.0075	ResSoil			Not detected and not greater than RBC
1,2-Dichlorobenzene	95-50-1	34	0	34				0.000495	0.065	7,000	ResSoil			Not detected and not greater than RBC
1,2-Dichloroethane	107-06-2	18	0	18				0.000445	0.0011	7	ResSoil			Not detected and not greater than RBC
1,2-Dichloropropane	78-87-5	18	0	18				0.000325	0.0008	9.4	ResSoil			Not detected and not greater than RBC
1,3-Dichlorobenzene	541-73-1	34	0	34				0.000355	0.07	2,300	ResSoil			Not detected and not greater than RBC
1,4-Dichlorobenzene	106-46-7	34	0	34				0.000475	0.065	27	ResSoil			Not detected and not greater than RBC
2-Butanone	78-93-3	18	12	6	67%	0.0017	0.0081	0.00065	0.00125	47,000	ResSoil			Det. Freq > 5% but RBC not exceeded
2-Hexanone	591-78-6	18	0	18				0.00055	0.00135	4,700	ResSoil			Not detected and not greater than RBC
4-Methyl-2-pentanone	108-10-1	18	0	18				0.000355	0.00085	6,300	ResSoil			Not detected and not greater than RBC
Acetone	67-64-1	18	18	0	100%	0.0027	0.061			70,000	ResSoil			Det. Freq > 5% but RBC not exceeded
Benzene	71-43-2	18	0	18				0.000455	0.0011	12	ResSoil			Not detected and not greater than RBC
Bromodichloromethane	75-27-4	18	0	18				0.000425	0.00105	10	ResSoil			Not detected and not greater than RBC
Bromoform	75-25-2	18	0	18				0.000385	0.00095	81	ResSoil			Not detected and not greater than RBC
Bromomethane	74-83-9	18	0	18				0.0006	0.00145	110	ResSoil			Not detected and not greater than RBC
Carbon Disulfide	75-15-0	18	0	18				0.0006	0.00145	7,800	ResSoil			Not detected and not greater than RBC

Table 3
Summary of COPC Selection Process
SOIL (Units mg/kg)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
Carbon Tetrachloride	56-23-5	18	0	18				0.00047	0.00115	4.9	ResSoil			Not detected and not greater than RBC
Chlorobenzene	108-90-7	18	0	18				0.000495	0.0012	1,600	ResSoil			Not detected and not greater than RBC
Chlorodibromomethane	124-48-1	18	0	18				0.000395	0.00095	7.6	ResSoil			Not detected and not greater than RBC
Chloroethane	75-00-3	18	0	18				0.00042	0.00105	220	ResSoil			Not detected and not greater than RBC
Chloroform	67-66-3	18	0	18				0.000425	0.00105	780	ResSoil			Not detected and not greater than RBC
Chloromethane	74-87-3	18	0	18				0.00039	0.00095	49	ResSoil			Not detected and not greater than RBC
Cyclohexane	110-82-7	18	0	18				0.0013	0.0032	390,000	ResSoil			Not detected and not greater than RBC
Dichlorodifluoromethane	75-71-8	18	0	18				0.000355	0.00085	16,000	ResSoil			Not detected and not greater than RBC
Ethylbenzene	100-41-4	18	0	18				0.00043	0.00105	7,800	ResSoil			Not detected and not greater than RBC
Fluorotrichloromethane	75-69-4	18	0	18				0.00055	0.00135	23,000	ResSoil			Not detected and not greater than RBC
Isopropylbenzene	98-82-8	18	0	18				0.000395	0.00095	7,800	ResSoil			Not detected and not greater than RBC
Methyl Acetate	79-20-9	18	0	18				0.0014	0.00345	78,000	ResSoil			Not detected and not greater than RBC
Methyl-tert-butyl-ether	1634-04-4	18	0	18				0.000465	0.00115	160	ResSoil			Not detected and not greater than RBC
Methylcyclohexane	108-87-2	18	0	18				0.00135	0.0033	390,000	ResSoil			Not detected and not greater than RBC
Methylene Chloride	75-09-2	18	12	6	67%	0.0016	0.0093	0.00045	0.0008	85	ResSoil			Det. Freq > 5% but RBC not exceeded
Styrene	100-42-5	18	0	18				0.0004	0.001	16,000	ResSoil			Not detected and not greater than RBC
Tetrachloroethene	127-18-4	18	0	18				0.00055	0.00135	1.2	ResSoil			Not detected and not greater than RBC
Toluene	108-88-3	18	0	18				0.000485	0.0012	16,000	ResSoil			Not detected and not greater than RBC
Trichloroethylene	79-01-6	18	0	18				0.0005	0.0012	1.6	ResSoil			Not detected and not greater than RBC
Vinyl Chloride	75-01-4	18	0	18				0.000445	0.0011	0.09	ResSoil			Not detected and not greater than RBC
Xylenes, m + p	108-38-3	36	0	36				0.0006	0.00245	16,000	ResSoil			Not detected and not greater than RBC
cis-1,2-Dichloroethene	156-59-2	18	0	18				0.0005	0.0012	780	ResSoil			Not detected and not greater than RBC
trans-1,2-Dichloroethene	156-60-5	18	0	18				0.000415	0.001	1,600	ResSoil			Not detected and not greater than RBC
trans-1,3-Dichloropropene	10061-02-6	36	0	36				0.000315	0.00085	6.4	ResSoil			Not detected and not greater than RBC

a - Comparison value based upon RDA - recommended daily allowance; ResSoil - EPA Region 3 residential soil risk-based concentration; and BackGrd - Illinois specific background.

b - COPC indicates Constituent of Potential Concern.

Table 4
Summary of COPC Selection Process
SEDIMENT (Units mg/kg)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
Calcium	7440-70-2	17	17	0	100%	1300	23000			1,000,000	RDA			Det. Freq > 5% but RBC not exceeded
Magnesium	7439-95-4	17	17	0	100%	740	5400			420,000	RDA			Det. Freq > 5% but RBC not exceeded
Potassium	7440-09-7	17	16	1	94%	270	1400	345	345	1,000,000	RDA			Det. Freq > 5% but RBC not exceeded
Sodium	7440-23-5	17	1	16	6%	150	150	10.5	48	1,000,000	RDA			Det. Freq > 5% but RBC not exceeded
Aluminum	7429-90-5	17	17	0	100%	2300	19000			78,000	ResSoil			Det. Freq > 5% but RBC not exceeded
Antimony	7440-36-0	17	16	1	94%	0.42	12	0.225	0.225	31	ResSoil			Det. Freq > 5% but RBC not exceeded
Arsenic	7440-38-2	17	17	0	100%	2.1	25			11.3	BackGrd	Yes		Det. Freq > 5% and exceeds RBC
Barium	7440-39-3	17	17	0	100%	30	190			5,500	ResSoil			Det. Freq > 5% but RBC not exceeded
Beryllium	7440-41-7	17	17	0	100%	0.27	1.1			160	ResSoil			Det. Freq > 5% but RBC not exceeded
Cadmium	7440-43-9	17	17	0	100%	0.48	550			78	ResSoil	Yes		Det. Freq > 5% and exceeds RBC
Chromium	16065-83-1	17	17	0	100%	5.9	27			230	ResSoil			Det. Freq > 5% but RBC not exceeded
Cobalt	7440-48-4	17	17	0	100%	1.2	14			1,600	ResSoil			Det. Freq > 5% but RBC not exceeded
Copper	7440-50-8	17	17	0	100%	4.8	320			3,100	ResSoil			Det. Freq > 5% but RBC not exceeded
Iron	7439-89-6	17	17	0	100%	5100	45000			23,000	ResSoil	Yes		Det. Freq > 5% and exceeds RBC
Lead	7439-92-1	17	17	0	100%	14	2700			400	ResSoil	Yes		Det. Freq > 5% and exceeds RBC
Manganese	7439-96-5	17	17	0	100%	70	750			1,600	ResSoil			Det. Freq > 5% but RBC not exceeded
Mercury	7439-97-6/	17	16	1	94%	0.0093	1.7	0.0023	0.0023	23	ResSoil			Det. Freq > 5% but RBC not exceeded
Nickel	7440-02-0	17	17	0	100%	4.2	29			1,600	ResSoil			Det. Freq > 5% but RBC not exceeded
Selenium	7782-49-2	17	3	14	18%	1.1	1.4	0.22	0.55	390	ResSoil			Det. Freq > 5% but RBC not exceeded
Silver	7440-22-4	17	8	9	47%	0.089	2.4	0.033	0.075	390	ResSoil			Det. Freq > 5% but RBC not exceeded
Thallium	7791-12-0	17	0	17				0.23	0.55	6.3	ResSoil			Not detected and not greater than RBC
Vanadium	7440-62-2	17	17	0	100%	7.8	34			23	ResSoil	Yes		Det. Freq > 5% and exceeds RBC
Zinc	7440-66-6	17	17	0	100%	310	23000			23,000	ResSoil			Det. Freq > 5% but RBC not exceeded
Aroclor 1016	12674-11-2	5	0	5				0.0085	0.0125	5.5	ResSoil			Not detected and not greater than RBC
Aroclor 1221	11104-28-2	5	0	5				0.0085	0.0125	0.32	ResSoil			Not detected and not greater than RBC
Aroclor 1232	11141-16-5	5	0	5				0.0085	0.0125	0.32	ResSoil			Not detected and not greater than RBC
Aroclor 1242	53469-21-9	5	0	5				0.0085	0.0125	0.32	ResSoil			Not detected and not greater than RBC
Aroclor 1248	12672-29-6	5	0	5				0.0085	0.0125	0.32	ResSoil			Not detected and not greater than RBC
Aroclor 1254	11097-69-1	5	0	5				0.0085	0.0125	0.32	ResSoil			Not detected and not greater than RBC
Aroclor 1260	11096-82-5	5	0	5				0.0085	0.0125	0.32	ResSoil			Not detected and not greater than RBC
2,2'-oxybis(1-Chloropropane)	108-60-1	5	0	5				0.0415	0.065	9.1	ResSoil			Not detected and not greater than RBC
2,4,5-Trichlorophenol	95-95-4	5	0	5				0.06	0.09	7,800	ResSoil			Not detected and not greater than RBC
2,4,6-Trichlorophenol	88-06-2	5	0	5				0.0385	0.06	58	ResSoil			Not detected and not greater than RBC
2,4-Dichlorophenol	120-83-2	5	0	5				0.06	0.09	230	ResSoil			Not detected and not greater than RBC
2,4-Dimethylphenol	105-67-9	5	0	5				0.085	0.125	1,600	ResSoil			Not detected and not greater than RBC
2,4-Dinitrophenol	51-28-5	5	0	5				0.08	0.12	160	ResSoil			Not detected and not greater than RBC

Table 4
Summary of COPC Selection Process
SEDIMENT (Units mg/kg)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
2,4-Dinitrotoluene	121-14-2	5	0	5				0.085	0.13	160	ResSoil			Not detected and not greater than RBC
2,6-Dinitrotoluene	606-20-2	5	0	5				0.05	0.08	78	ResSoil			Not detected and not greater than RBC
2-Chloronaphthalene	91-58-7	5	0	5				0.045	0.07	6,300	ResSoil			Not detected and not greater than RBC
2-Chlorophenol	95-57-8	5	0	5				0.05	0.08	390	ResSoil			Not detected and not greater than RBC
2-Methylnaphthalene	91-57-6	5	0	5				0.05	0.08	1,600	ResSoil			Not detected and not greater than RBC
2-Methylphenol	95-48-7	5	0	5				0.06	0.09	3,900	ResSoil			Not detected and not greater than RBC
2-Nitroaniline	88-74-4	5	0	5				0.085	0.125	230	ResSoil			Not detected and not greater than RBC
2-Nitrophenol	88-75-5	5	0	5				0.048	0.075	160	ResSoil			Not detected and not greater than RBC
3,3-Dichlorobenzidine	91-94-1	5	0	5				0.085	0.125	1.4	ResSoil			Not detected and not greater than RBC
3-Nitroaniline	99-09-2	5	0	5				0.032	0.0485	23	ResSoil			Not detected and not greater than RBC
4,6-Dinitro-2-methylphenol	534-52-1	5	0	5				0.065	0.1	7.8	ResSoil			Not detected and not greater than RBC
4-Bromophenyl phenyl ether	*101-55-3*	*5*	*0*	*5*				*0.0385*	*0.06*	*0.043*	*ResSoil*		*Yes*	*Not detected but greater than RBC*
4-Chloro-3-methylphenol	59-50-7	5	0	5				0.065	0.1	390	ResSoil			Not detected and not greater than RBC
4-Chloroaniline	106-47-8	5	0	5				0.0385	0.06	310	ResSoil			Not detected and not greater than RBC
4-Chlorophenyl phenyl ether	*7005-72-3*	*5*	*0*	*5*				*0.06*	*0.09*	*0.043*	*ResSoil*		*Yes*	*Not detected but greater than RBC*
4-Methylphenol	106-44-5	5	0	5				0.05	0.08	390	ResSoil			Not detected and not greater than RBC
4-Nitroaniline	100-01-6	5	0	5				0.155	0.235	32	ResSoil			Not detected and not greater than RBC
4-Nitrophenol	100-02-7	5	0	5				0.15	0.23	160	ResSoil			Not detected and not greater than RBC
Acenaphthylene	208-96-8	10	0	10				0.048	0.085	4,700	ResSoil			Not detected and not greater than RBC
Acetophenone	98-86-2	5	0	5				0.06	0.09	7,800	ResSoil			Not detected and not greater than RBC
Anthracene	120-12-7	5	0	5				0.0415	0.065	23,000	ResSoil			Not detected and not greater than RBC
Atrazine	1912-24-9	5	0	5				0.0385	0.06	2.9	ResSoil			Not detected and not greater than RBC
Benzaldehyde	100-52-7	5	0	5				0.045	0.07	7,800	ResSoil			Not detected and not greater than RBC
Benzo(a)anthracene	56-55-3	5	0	5				0.06	0.09	0.87	ResSoil			Not detected and not greater than RBC
Benzo(a)pyrene	50-32-8	5	0	5				0.048	0.075	0.087	ResSoil			Not detected and not greater than RBC
Benzo(b)fluoranthene	205-99-2	5	0	5				0.075	0.115	0.87	ResSoil			Not detected and not greater than RBC
Benzo(k)fluoranthene	207-08-9	5	0	5				0.065	0.095	8.7	ResSoil			Not detected and not greater than RBC
Biphenyl	92-52-4	5	0	5				0.05	0.08	3,900	ResSoil			Not detected and not greater than RBC
Butylbenzylphthalate	85-68-7	5	0	5				0.05	0.08	16,000	ResSoil			Not detected and not greater than RBC
Caprolactam	105-60-2	5	0	5				0.048	0.075	39,000	ResSoil			Not detected and not greater than RBC
Carbazole	86-74-8	5	0	5				0.1	0.15	32	ResSoil			Not detected and not greater than RBC
Chrysene	218-01-9	5	0	5				0.065	0.1	87	ResSoil			Not detected and not greater than RBC
Di-n-butylphthalate	84-74-2	5	0	5				0.05	0.08	7,800	ResSoil			Not detected and not greater than RBC
Di-n-octylphthalate	117-84-0	5	0	5				0.065	0.1	3,100	ResSoil			Not detected and not greater than RBC
Dibenzo(a,h)anthracene	53-70-3	5	0	5				0.0385	0.06	0.087	ResSoil			Not detected and not greater than RBC
Dibenzofuran	132-64-9	5	0	5				0.065	0.095	160	ResSoil			Not detected and not greater than RBC

Table 4
Summary of COPC Selection Process
SEDIMENT (Units mg/kg)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
Diethylphthalate	84-66-2	5	0	5				0.065	0.095	63,000	ResSoil			Not detected and not greater than RBC
Dimethylphthalate	131-11-3	5	0	5				0.06	0.09	780,000	ResSoil			Not detected and not greater than RBC
Fluoranthene	206-44-0	5	0	5				0.075	0.11	3,100	ResSoil			Not detected and not greater than RBC
Fluorene	86-73-7	5	0	5				0.065	0.095	3,100	ResSoil			Not detected and not greater than RBC
Hexachlorobenzene	118-74-1	5	0	5				0.032	0.0485	0.4	ResSoil			Not detected and not greater than RBC
Hexachlorobutadiene	87-68-3	5	0	5				0.06	0.09	8.2	ResSoil			Not detected and not greater than RBC
Hexachlorocyclopentadiene	77-47-4	5	0	5				0.0385	0.06	470	ResSoil			Not detected and not greater than RBC
Hexachloroethane	67-72-1	5	0	5				0.055	0.085	46	ResSoil			Not detected and not greater than RBC
Indeno(1,2,3-cd)pyrene	193-39-5	5	0	5				0.048	0.075	0.87	ResSoil			Not detected and not greater than RBC
Isophorone	78-59-1	5	0	5				0.0385	0.06	670	ResSoil			Not detected and not greater than RBC
N-Nitroso-di-n-propylamine	621-64-7	5	0	5				0.0415	0.065	0.091	ResSoil			Not detected and not greater than RBC
N-Nitrosodiphenylamine	86-30-6	5	0	5				0.055	0.085	130	ResSoil			Not detected and not greater than RBC
Naphthalene	91-20-3	5	0	5				0.055	0.085	1,600	ResSoil			Not detected and not greater than RBC
Nitrobenzene	98-95-3	5	0	5				0.055	0.085	39	ResSoil			Not detected and not greater than RBC
Pentachlorophenol	87-86-5	5	0	5				0.065	0.1	5.3	ResSoil			Not detected and not greater than RBC
Phenol	108-95-2	5	0	5				0.0385	0.06	23,000	ResSoil			Not detected and not greater than RBC
Pyrene	129-00-0	15	0	15				0.0415	0.11	2,300	ResSoil			Not detected and not greater than RBC
bis(2-Chloroethoxy)methane	111-91-1	5	0	5				0.048	0.075	0.58	ResSoil			Not detected and not greater than RBC
bis(2-Chloroethyl)ether	111-44-4	5	0	5				0.045	0.07	0.58	ResSoil			Not detected and not greater than RBC
bis(2-Ethylhexyl)phthalate	117-81-7	5	0	5				0.05	0.08	46	ResSoil			Not detected and not greater than RBC
1,1,1-Trichloroethane	71-55-6	7	0	7				0.000485	1.6	22,000	ResSoil			Not detected and not greater than RBC
1,1,2,2-Tetrachloroethane	79-34-5	7	0	7				0.0005	1.55	3.2	ResSoil			Not detected and not greater than RBC
1,1,2-Trichloroethane	79-00-5	7	0	7				0.00044	1.45	11	ResSoil			Not detected and not greater than RBC
1,1,2-Trichlorotrifluoroethane	76-13-1	7	0	7				0.0006	2.7	2,300,000	ResSoil			Not detected and not greater than RBC
1,1-Dichloroethane	75-34-3	7	0	7				0.0005	2.25	7,800	ResSoil			Not detected and not greater than RBC
1,1-Dichloroethene	75-35-4	7	0	7				0.0006	2.25	3,900	ResSoil			Not detected and not greater than RBC
1,2,4-Trichlorobenzene	120-82-1	12	0	12				0.00055	1.75	780	ResSoil			Not detected and not greater than RBC
1,2-Dibromo-3-chloropropane	*96-12-8*	*7*	*0*	*7*				*0.0006*	*2.85*	*0.46*	*ResSoil*		*Yes*	*Not detected but greater than RBC*
1,2-Dibromoethane	*106-93-4*	*7*	*0*	*7*				*0.000445*	*1.9*	*0.0075*	*ResSoil*		*Yes*	*Not detected but greater than RBC*
1,2-Dichlorobenzene	95-50-1	12	0	12				0.0006	1.25	7,000	ResSoil			Not detected and not greater than RBC
1,2-Dichloroethane	107-06-2	7	0	7				*0.00055*	*1.45*	7	ResSoil			*Not detected and not greater than RBC*
1,2-Dichloropropane	78-87-5	7	0	7				*0.00039*	*1.6*	9.4	ResSoil			*Not detected and not greater than RBC*
1,3-Dichlorobenzene	541-73-1	12	0	12				0.000425	1	2,300	ResSoil			Not detected and not greater than RBC
1,4-Dichlorobenzene	106-46-7	12	0	12				0.00055	1.35	27	ResSoil			Not detected and not greater than RBC
2-Butanone	78-93-3	7	4	3	57%	0.0016	0.02	4.9	7	47,000	ResSoil			Det. Freq > 5% but RBC not exceeded
2-Hexanone	591-78-6	7	0	7				0.00065	4.15	4,700	ResSoil			Not detected and not greater than RBC

Table 4
Summary of COPC Selection Process
SEDIMENT (Units mg/kg)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
4-Methyl-2-pentanone	108-10-1	7	0	7				0.000425	3.35	6,300	ResSoil			Not detected and not greater than RBC
Acetone	67-64-1	7	4	3	57%	0.0032	0.049	1.75	2.55	70,000	ResSoil			Det. Freq > 5% but RBC not exceeded
Benzene	71-43-2	7	0	7				0.00055	1.1	12	ResSoil			Not detected and not greater than RBC
Bromodichloromethane	75-27-4	7	0	7				0.0005	1.75	10	ResSoil			Not detected and not greater than RBC
Bromoform	75-25-2	7	0	7				0.000465	2.1	81	ResSoil			Not detected and not greater than RBC
Bromomethane	74-83-9	7	0	7				0.0007	4.65	110	ResSoil			Not detected and not greater than RBC
Carbon Disulfide	75-15-0	7	0	7				0.0007	2.7	7,800	ResSoil			Not detected and not greater than RBC
Carbon Tetrachloride	56-23-5	7	0	7				0.00055	1.75	4.9	ResSoil			Not detected and not greater than RBC
Chlorobenzene	108-90-7	7	0	7				0.0006	1.3	1,600	ResSoil			Not detected and not greater than RBC
Chlorodibromomethane	124-48-1	7	0	7				0.000475	1.9	7.6	ResSoil			Not detected and not greater than RBC
Chloroethane	75-00-3	7	0	7				0.0005	3.05	220	ResSoil			Not detected and not greater than RBC
Chloroform	67-66-3	7	0	7				0.0005	1.75	780	ResSoil			Not detected and not greater than RBC
Chloromethane	74-87-3	7	0	7				0.00047	2.55	49	ResSoil			Not detected and not greater than RBC
Cyclohexane	110-82-7	7	0	7				0.00155	1.6	390,000	ResSoil			Not detected and not greater than RBC
Dichlorodifluoromethane	75-71-8	7	0	7				0.000425	1.9	16,000	ResSoil			Not detected and not greater than RBC
Ethylbenzene	100-41-4	7	0	7				0.0005	1.05	7,800	ResSoil			Not detected and not greater than RBC
Fluorotrichloromethane	75-69-4	7	0	7				0.00065	1.6	23,000	ResSoil			Not detected and not greater than RBC
Isopropylbenzene	98-82-8	7	0	7				0.000475	0.95	7,800	ResSoil			Not detected and not greater than RBC
Methyl Acetate	79-20-9	7	0	7				0.0017	3.65	78,000	ResSoil			Not detected and not greater than RBC
Methyl-tert-butyl-ether	1634-04-4	7	0	7				0.00055	1.75	160	ResSoil			Not detected and not greater than RBC
Methylcyclohexane	108-87-2	7	0	7				0.0016	1.6	390,000	ResSoil			Not detected and not greater than RBC
Methylene Chloride	75-09-2	7	0	7				0.00055	2.25	85	ResSoil			Not detected and not greater than RBC
Styrene	100-42-5	7	0	7				0.00048	1.1	16,000	ResSoil			Not detected and not greater than RBC
Tetrachloroethene	*127-18-4*	*7*	*0*	*7*				*0.00065*	*2.4*	*1.2*	*ResSoil*		*Yes*	*Not detected but greater than RBC*
Toluene	108-88-3	7	0	7				0.0006	1.9	16,000	ResSoil			Not detected and not greater than RBC
Trichloroethylene	79-01-6	7	5	2	71%	0.003	13	0.0006	0.0007	1.6	ResSoil	Yes		Det. Freq > 5% and exceeds RBC
Vinyl Chloride	*75-01-4*	*7*	*2*	*5*	*29%*	*0.0025*	*0.013*	*0.00055*	*2.55*	*0.09*	*ResSoil*		*Yes*	*Det. Freq > 5% but RBC not exceeded*
Xylenes, m + p	108-38-3	14	0	14				0.0007	2.1	16,000	ResSoil			Not detected and not greater than RBC
cis-1,2-Dichloroethene	156-59-2	7	2	5	29%	0.0041	0.086	0.0006	1.9	780	ResSoil			Det. Freq > 5% but RBC not exceeded
trans-1,2-Dichloroethene	156-60-5	7	2	5	29%	0.0056	0.02	0.0005	1.75	1,600	ResSoil			Det. Freq > 5% but RBC not exceeded
trans-1,3-Dichloropropene	10061-02-6	14	0	14				0.00038	1.75	6.4	ResSoil			Not detected and not greater than RBC

a - Comparison value based upon RDA - recommended daily allowance; ResSoil - EPA Region 3 residential soil risk-based concentration; and BackGrd - Illinois specific background.

b - COPC indicates Constituent of Potential Concern.

Table 5
Summary of COPC Selection Process
GROUNDWATER (Units mg/liter)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
Calcium	7440-70-2	19	19	0	100%	25	320			.	TapWater			
Calcium - Dissolved	7440-70-2	19	19	0	100%	9.6	360			.	TapWater			
Magnesium	7439-95-4	19	19	0	100%	13	290			.	TapWater			
Magnesium - Dissolved	7439-95-4	19	19	0	100%	3.9	340			.	TapWater			
Potassium	7440-09-7	19	19	0	100%	0.19	15			.	TapWater			
Potassium - Dissolved	7440-09-7	19	19	0	100%	0.14	18			.	TapWater			
Sodium	7440-23-5	19	19	0	100%	7	120			.	TapWater			
Sodium - Dissolved	7440-23-5	19	19	0	100%	8.2	130			.	TapWater			
Sulfate	14808-79-8	19	19	0	100%	23	1700			500	Ill. Std.	Yes		Det. Freq > 5% and exceeds RBC
Aluminum	7429-90-5	19	17	2	89%	0.033	110	0.0135	0.0135	37	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Aluminum - Dissolved	7429-90-5	19	11	8	58%	0.027	0.23	0.0135	0.0135	37	TapWater			Det. Freq > 5% but RBC not exceeded
Antimony	7440-36-0	19	5	14	26%	0.0025	0.01	0.00125	0.00125	0.015	TapWater			Det. Freq > 5% but RBC not exceeded
Antimony - Dissolved	7440-36-0	19	1	18	5%	0.0028	0.0028	0.00125	0.00125	0.015	TapWater			Det. Freq > 5% but RBC not exceeded
Arsenic	7440-38-2	19	4	15	21%	0.017	0.075	0.00405	0.00405	0.000045	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Arsenic - Dissolved	*7440-38-2*	*19*	*0*	*19*				*0.00405*	*0.00405*	*0.000045*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Barium	7440-39-3	19	19	0	100%	0.012	1.2			2.6	TapWater			Det. Freq > 5% but RBC not exceeded
Barium - Dissolved	7440-39-3	19	19	0	100%	0.011	0.094			2.6	TapWater			Det. Freq > 5% but RBC not exceeded
Beryllium	7440-41-7	19	4	15	21%	0.0036	0.008	0.000305	0.00055	0.073	TapWater			Det. Freq > 5% but RBC not exceeded
Beryllium - Dissolved	7440-41-7	19	0	19				0.000305	0.000305	0.073	TapWater			Not detected and not greater than RBC
Cadmium	7440-43-9	19	7	12	37%	0.00073	0.39	0.000265	0.000265	0.018	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Cadmium - Dissolved	7440-43-9	19	7	12	37%	0.00071	0.33	0.000265	0.000265	0.018	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Chromium	16065-83-1	19	8	11	42%	0.0012	0.17	0.000465	0.000465	0.11	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Chromium - Dissolved	16065-83-1	19	12	7	63%	0.001	0.0028	0.000465	0.000465	0.11	TapWater			Det. Freq > 5% but RBC not exceeded
Cobalt	7440-48-4	19	12	7	63%	0.0011	0.079	0.00046	0.00046	0.73	TapWater			Det. Freq > 5% but RBC not exceeded
Cobalt - Dissolved	7440-48-4	19	9	10	47%	0.0015	0.044	0.00046	0.00046	0.73	TapWater			Det. Freq > 5% but RBC not exceeded
Copper	7440-50-8	19	12	7	63%	0.001	0.95	0.00045	0.00045	1.5	TapWater			Det. Freq > 5% but RBC not exceeded
Copper - Dissolved	7440-50-8	19	2	17	11%	0.002	0.0038	0.00045	0.00045	1.5	TapWater			Det. Freq > 5% but RBC not exceeded
Iron	7439-89-6	19	19	0	100%	0.04	210			11	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Iron - Dissolved	7439-89-6	19	4	15	21%	0.029	9.5	0.0095	0.0095	11	TapWater			Det. Freq > 5% but RBC not exceeded
Lead	7439-92-1	19	8	11	42%	0.0034	0.93	0.00065	0.00065	0.015	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Lead - Dissolved	7439-92-1	19	3	16	16%	0.0015	0.018	0.00065	0.00065	0.015	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Manganese	7439-96-5	19	19	0	100%	0.0044	12			0.73	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Manganese - Dissolved	7439-96-5	19	19	0	100%	0.0014	13			0.73	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Mercury	7439-97-6/	19	5	14	26%	0.000086	0.00045	0.000014	0.000014	0.011	TapWater			Det. Freq > 5% but RBC not exceeded
Mercury - Dissolved	7439-97-6/	19	1	18	5%	0.000043	0.000043	0.000014	0.000014	0.011	TapWater			Det. Freq > 5% but RBC not exceeded

Table 5
Summary of COPC Selection Process
GROUNDWATER (Units mg/liter)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples #	DT	ND	Frequency of Detection	Detected Concentration Min	Max	Detection Limits Min	Max	Comparison RBC Value	Note[a]	COPC[b]	Address in Uncertainty	Rationale
Nickel	7440-02-0	19	19	0	100%	0.0013	0.23			0.73	TapWater			Det. Freq > 5% but RBC not exceeded
Nickel - Dissolved	7440-02-0	19	13	6	68%	0.0022	0.091	0.0006	0.0006	0.73	TapWater			Det. Freq > 5% but RBC not exceeded
Selenium	7782-49-2	19	2	17	11%	0.0077	0.011	0.0024	0.0048	0.18	TapWater			Det. Freq > 5% but RBC not exceeded
Selenium - Dissolved	7782-49-2	19	0	19				0.0024	0.0024	0.18	TapWater			Not detected and not greater than RBC
Silver	7440-22-4	19	1	18	5%	0.0019	0.0019	0.00055	0.00055	0.18	TapWater			Det. Freq > 5% but RBC not exceeded
Silver - Dissolved	7440-22-4	19	0	19				0.00055	0.00055	0.18	TapWater			Not detected and not greater than RBC
Thallium	7791-12-0	19	1	18	5%	0.0043	0.0043	0.00215	0.00215	0.0029	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Thallium - Dissolved	7791-12-0	19	1	18	5%	0.0074	0.0074	0.00215	0.00215	0.0029	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Vanadium	7440-62-2	19	14	5	74%	0.00086	0.2	0.00042	0.00042	0.011	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Vanadium - Dissolved	7440-62-2	19	2	17	11%	0.00088	0.0011	0.00042	0.00042	0.011	TapWater			Det. Freq > 5% but RBC not exceeded
Zinc	7440-66-6	19	19	0	100%	0.0035	210			11	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Zinc - Dissolved	7440-66-6	19	19	0	100%	0.005	120			11	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Aroclor 1016	12674-11-2	5	0	5				0.000135	0.00014	0.00096	TapWater			Not detected and not greater than RBC
Aroclor 1221	*11104-28-2*	*5*	*0*	*5*				*0.000135*	*0.00014*	*0.000033*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Aroclor 1232	*11141-16-5*	*5*	*0*	*5*				*0.000135*	*0.00014*	*0.000033*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Aroclor 1242	*53469-21-9*	*5*	*0*	*5*				*0.000135*	*0.00014*	*0.000033*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Aroclor 1248	*12672-29-6*	*5*	*0*	*5*				*0.000135*	*0.00014*	*0.000033*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Aroclor 1254	*11097-69-1*	*5*	*0*	*5*				*0.000135*	*0.00014*	*0.000033*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Aroclor 1260	*11096-82-5*	*5*	*0*	*5*				*0.000135*	*0.00014*	*0.000033*	*TapWater*		*Yes*	*Not detected but greater than RBC*
2,2'-oxybis(1-Chloropropane)	*108-60-1*	*5*	*0*	*5*				*0.0018*	*0.0022*	*0.00026*	*TapWater*		*Yes*	*Not detected but greater than RBC*
2,4,5-Trichlorophenol	95-95-4	5	0	5				0.0023	0.00285	3.7	TapWater			Not detected and not greater than RBC
2,4,6-Trichlorophenol	88-06-2	5	0	5				0.002	0.00245	0.0061	TapWater			Not detected and not greater than RBC
2,4-Dichlorophenol	120-83-2	5	0	5				0.00185	0.0023	0.11	TapWater			Not detected and not greater than RBC
2,4-Dimethylphenol	105-67-9	5	0	5				0.00145	0.0018	0.73	TapWater			Not detected and not greater than RBC
2,4-Dinitrophenol	51-28-5	5	0	5				0.0015	0.00185	0.073	TapWater			Not detected and not greater than RBC
2,4-Dinitrotoluene	121-14-2	5	0	5				0.00085	0.00105	0.073	TapWater			Not detected and not greater than RBC
2,6-Dinitrotoluene	606-20-2	5	0	5				0.00185	0.0023	0.037	TapWater			Not detected and not greater than RBC
2-Chloronaphthalene	91-58-7	5	0	5				0.0021	0.0026	0.49	TapWater			Not detected and not greater than RBC
2-Chlorophenol	95-57-8	5	0	5				0.00055	0.0007	0.03	TapWater			Not detected and not greater than RBC
2-Methylnaphthalene	91-57-6	5	0	5				0.00195	0.0024	0.12	TapWater			Not detected and not greater than RBC
2-Methylphenol	95-48-7	5	0	5				0.00115	0.0014	1.8	TapWater			Not detected and not greater than RBC
2-Nitroaniline	88-74-4	5	0	5				0.0021	0.0026	0.11	TapWater			Not detected and not greater than RBC
2-Nitrophenol	88-75-5	5	0	5				0.00185	0.0023	0.015	TapWater			Not detected and not greater than RBC
3,3-Dichlorobenzidine	*91-94-1*	*5*	*0*	*5*				*0.0014*	*0.00175*	*0.00015*	*TapWater*		*Yes*	*Not detected but greater than RBC*
3-Nitroaniline	99-09-2	5	0	5				0.0014	0.00175	0.0033	TapWater			Not detected and not greater than RBC

Table 5
Summary of COPC Selection Process
GROUNDWATER (Units mg/liter)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
4,6-Dinitro-2-methylphenol	534-52-1	5	0	5				0.00085	0.00105	0.0037	TapWater			Not detected and not greater than RBC
4-Bromophenyl phenyl ether	*101-55-3*	*5*	*0*	*5*				*0.0018*	*0.0022*	*1.00E-06*	*TapWater*		*Yes*	*Not detected but greater than RBC*
4-Chloro-3-methylphenol	59-50-7	5	0	5				0.00205	0.00255	0.037	TapWater			Not detected and not greater than RBC
4-Chloroaniline	106-47-8	5	0	5				0.0021	0.0026	0.15	TapWater			Not detected and not greater than RBC
4-Chlorophenyl phenyl ether	*7005-72-3*	*5*	*0*	*5*				*0.00235*	*0.0029*	*1.00E-06*	*TapWater*		*Yes*	*Not detected but greater than RBC*
4-Methylphenol	106-44-5	5	0	5				0.001	0.00125	0.18	TapWater			Not detected and not greater than RBC
4-Nitroaniline	100-01-6	5	0	5				0.0009	0.0011	0.0033	TapWater			Not detected and not greater than RBC
4-Nitrophenol	100-02-7	5	0	5				0.0009	0.0011	0.15	TapWater			Not detected and not greater than RBC
Acenaphthylene	208-96-8	10	0	10				0.0023	0.0029	0.37	TapWater			Not detected and not greater than RBC
Acetophenone	98-86-2	5	0	5				0.00225	0.0028	0.61	TapWater			Not detected and not greater than RBC
Anthracene	120-12-7	5	0	5				0.0014	0.00175	1.8	TapWater			Not detected and not greater than RBC
Atrazine	*1912-24-9*	*5*	*0*	*5*				*0.0011*	*0.00135*	*0.0003*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Benzaldehyde	100-52-7	5	0	5				0.0041	0.005	3.7	TapWater			Not detected and not greater than RBC
Benzo(a)anthracene	*56-55-3*	*5*	*0*	*5*				*0.00085*	*0.00105*	*0.000092*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Benzo(a)pyrene	*50-32-8*	*5*	*0*	*5*				*0.00075*	*0.00095*	*9.20E-06*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Benzo(b)fluoranthene	*205-99-2*	*5*	*0*	*5*				*0.0011*	*0.00135*	*0.000092*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Benzo(k)fluoranthene	*207-08-9*	*5*	*0*	*5*				*0.0012*	*0.0015*	*0.00092*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Biphenyl	92-52-4	5	0	5				0.00265	0.00325	0.3	TapWater			Not detected and not greater than RBC
Butylbenzylphthalate	85-68-7	5	0	5				0.0009	0.0011	7.3	TapWater			Not detected and not greater than RBC
Caprolactam	105-60-2	5	2	3	40%	0.0029	0.1	0.00065	0.0008	18	TapWater			Det. Freq > 5% but RBC not exceeded
Carbazole	86-74-8	5	0	5				0.0007	0.00085	0.0033	TapWater			Not detected and not greater than RBC
Chrysene	218-01-9	5	0	5				0.0009	0.0011	0.0092	TapWater			Not detected and not greater than RBC
Di-n-butylphthalate	84-74-2	5	0	5				0.0007	0.00085	3.7	TapWater			Not detected and not greater than RBC
Di-n-octylphthalate	117-84-0	5	0	5				0.00065	0.0008	1.5	TapWater			Not detected and not greater than RBC
Dibenzo(a,h)anthracene	*53-70-3*	*5*	*0*	*5*				*0.0012*	*0.0015*	*9.20E-06*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Dibenzofuran	132-64-9	5	0	5				0.00235	0.0029	0.012	TapWater			Not detected and not greater than RBC
Diethylphthalate	84-66-2	5	0	5				0.00135	0.00165	29	TapWater			Not detected and not greater than RBC
Dimethylphthalate	131-11-3	5	0	5				0.00175	0.00215	370	TapWater			Not detected and not greater than RBC
Fluoranthene	206-44-0	5	0	5				0.0008	0.001	1.5	TapWater			Not detected and not greater than RBC
Fluorene	86-73-7	5	0	5				0.00235	0.0029	0.24	TapWater			Not detected and not greater than RBC
Hexachlorobenzene	*118-74-1*	*5*	*0*	*5*				*0.0007*	*0.00085*	*0.000042*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Hexachlorobutadiene	*87-68-3*	*5*	*0*	*5*				*0.00145*	*0.0018*	*0.00086*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Hexachlorocyclopentadiene	77-47-4	5	0	5				0.0007	0.00085	0.22	TapWater			Not detected and not greater than RBC
Hexachloroethane	67-72-1	5	0	5				0.00115	0.0014	0.0048	TapWater			Not detected and not greater than RBC
Indeno(1,2,3-cd)pyrene	*193-39-5*	*5*	*0*	*5*				*0.0008*	*0.001*	*0.000092*	*TapWater*		*Yes*	*Not detected but greater than RBC*

Table 5
Summary of COPC Selection Process
GROUNDWATER (Units mg/liter)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
Isophorone	78-59-1	5	0	5				0.00225	0.0028	0.07	TapWater			Not detected and not greater than RBC
N-Nitroso-di-n-propylamine	*621-64-7*	*5*	*0*	*5*				*0.00215*	*0.00265*	*9.60E-06*	*TapWater*		*Yes*	*Not detected but greater than RBC*
N-Nitrosodiphenylamine	86-30-6	5	0	5				0.0011	0.00135	0.014	TapWater			Not detected and not greater than RBC
Naphthalene	91-20-3	5	0	5				0.0019	0.00235	0.0065	TapWater			Not detected and not greater than RBC
Nitrobenzene	98-95-3	5	0	5				0.00175	0.00215	0.0035	TapWater			Not detected and not greater than RBC
Pentachlorophenol	87-86-5	5	0	5				0.00039	0.00048	0.00056	TapWater			Not detected and not greater than RBC
Phenol	108-95-2	5	0	5				0.0005	0.0006	11	TapWater			Not detected and not greater than RBC
Pyrene	129-00-0	15	0	15				0.0009	0.0013	0.18	TapWater			Not detected and not greater than RBC
bis(2-Chloroethoxy)methane	*111-91-1*	*5*	*0*	*5*				*0.00225*	*0.0028*	*0.00001*	*TapWater*		*Yes*	*Not detected but greater than RBC*
bis(2-Chloroethyl)ether	*111-44-4*	*5*	*0*	*5*				*0.000435*	*0.00055*	*9.60E-06*	*TapWater*		*Yes*	*Not detected but greater than RBC*
bis(2-Ethylhexyl)phthalate	117-81-7	5	0	5				0.0007	0.00085	0.0048	TapWater			Not detected and not greater than RBC
1,1,1-Trichloroethane	71-55-6	5	0	5				0.000325	0.00045	3.2	TapWater			Not detected and not greater than RBC
1,1,2,2-Tetrachloroethane	*79-34-5*	*5*	*0*	*5*				*0.0001*	*0.000385*	*0.000053*	*TapWater*		*Yes*	*Not detected but greater than RBC*
1,1,2-Trichloroethane	*79-00-5*	*5*	*0*	*5*				*0.00021*	*0.00025*	*0.00019*	*TapWater*		*Yes*	*Not detected but greater than RBC*
1,1,2-Trichlorotrifluoroethane	76-13-1	4	0	4				0.00027	0.000465	59	TapWater			Not detected and not greater than RBC
1,1-Dichloroethane	75-34-3	5	0	5				0.000375	0.000435	0.8	TapWater			Not detected and not greater than RBC
1,1-Dichloroethene	75-35-4	5	0	5				0.00028	0.000285	0.35	TapWater			Not detected and not greater than RBC
1,2,4-Trichlorobenzene	120-82-1	9	0	9				0.000285	0.00185	0.0072	TapWater			Not detected and not greater than RBC
1,2-Dibromo-3-chloropropane	*96-12-8*	*4*	*0*	*4*				*0.000435*	*0.00044*	*0.000047*	*TapWater*		*Yes*	*Not detected but greater than RBC*
1,2-Dibromoethane	*106-93-4*	*4*	*0*	*4*				*0.00028*	*0.00033*	*7.50E-07*	*TapWater*		*Yes*	*Not detected but greater than RBC*
1,2-Dichlorobenzene	95-50-1	9	0	9				0.000355	0.00155	0.27	TapWater			Not detected and not greater than RBC
1,2-Dichloroethane	*107-06-2*	*5*	*0*	*5*				*0.00018*	*0.000275*	*0.00012*	*TapWater*		*Yes*	*Not detected but greater than RBC*
1,2-Dichloroethene, Total	540-59-0	1	0	1				0.0006	0.0006	0.055	TapWater			Not detected and not greater than RBC
1,2-Dichloropropane	*78-87-5*	*5*	*0*	*5*				*0.000195*	*0.00023*	*0.00016*	*TapWater*		*Yes*	*Not detected but greater than RBC*
1,3-Dichlorobenzene	541-73-1	9	0	9				0.00029	0.0014	0.18	TapWater			Not detected and not greater than RBC
1,4-Dichlorobenzene	*106-46-7*	*9*	*0*	*9*				*0.000315*	*0.0014*	*0.00047*	*TapWater*		*Yes*	*Not detected but greater than RBC*
2-Butanone	78-93-3	5	4	1	80%	0.004	0.004	0.00215	0.00215	7	TapWater			Det. Freq > 5% but RBC not exceeded
2-Hexanone	591-78-6	5	0	5				0.00055	0.0006	0.44	TapWater			Not detected and not greater than RBC
4-Methyl-2-pentanone	108-10-1	5	0	5				0.000455	0.0006	0.58	TapWater			Not detected and not greater than RBC
Acetone	67-64-1	5	4	1	80%	0.0033	0.0033	0.0011	0.0011	5.5	TapWater			Det. Freq > 5% but RBC not exceeded
Benzene	71-43-2	5	0	5				0.000125	0.000205	0.00034	TapWater			Not detected and not greater than RBC
Bromodichloromethane	*75-27-4*	*5*	*0*	*5*				*0.000115*	*0.00028*	*0.00017*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Bromoform	75-25-2	5	0	5				0.000225	0.00047	0.0085	TapWater			Not detected and not greater than RBC
Bromomethane	74-83-9	5	0	5				0.000435	0.000455	0.0085	TapWater			Not detected and not greater than RBC
Carbon Disulfide	75-15-0	5	0	5				0.00025	0.00033	1	TapWater			Not detected and not greater than RBC

Table 5
Summary of COPC Selection Process
GROUNDWATER (Units mg/liter)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
Carbon Tetrachloride	*56-23-5*	*5*	*0*	*5*				*0.000235*	*0.000245*	*0.00016*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Chlorobenzene	108-90-7	5	0	5				0.000205	0.00029	0.11	TapWater			Not detected and not greater than RBC
Chlorodibromomethane	*124-48-1*	*5*	*0*	*5*				*0.000405*	*0.00042*	*0.00013*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Chloroethane	75-00-3	5	0	5				0.00042	0.000485	0.0036	TapWater			Not detected and not greater than RBC
Chloroform	*67-66-3*	*5*	*0*	*5*				*0.000185*	*0.000225*	*0.00015*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Chloromethane	74-87-3	5	0	5				0.00012	0.000135	0.0008	TapWater			Not detected and not greater than RBC
Cyclohexane	110-82-7	4	0	4				0.000445	0.0006	36.5	TapWater			Not detected and not greater than RBC
Dichlorodifluoromethane	75-71-8	4	0	4				0.000285	0.000495	0.35	TapWater			Not detected and not greater than RBC
Ethylbenzene	100-41-4	5	0	5				0.000265	0.00027	1.3	TapWater			Not detected and not greater than RBC
Fluorotrichloromethane	75-69-4	4	0	4				0.000395	0.000425	1.3	TapWater			Not detected and not greater than RBC
Isopropylbenzene	98-82-8	4	0	4				0.000295	0.00033	0.66	TapWater			Not detected and not greater than RBC
Methyl Acetate	79-20-9	4	0	4				0.00095	0.00105	6.1	TapWater			Not detected and not greater than RBC
Methyl-tert-butyl-ether	1634-04-4	4	0	4				0.000305	0.000435	0.0026	TapWater			Not detected and not greater than RBC
Methylcyclohexane	108-87-2	4	0	4				0.000365	0.00095	36.5	TapWater			Not detected and not greater than RBC
Methylene Chloride	75-09-2	5	0	5				0.000215	0.000235	0.0041	TapWater			Not detected and not greater than RBC
Styrene	100-42-5	5	0	5				0.00031	0.00043	1.6	TapWater			Not detected and not greater than RBC
Tetrachloroethylene	*127-18-4*	*5*	*0*	*5*				*0.000225*	*0.000315*	*0.0001*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Toluene	108-88-3	5	0	5				0.000335	0.00042	0.75	TapWater			Not detected and not greater than RBC
Trichloroethene	*79-01-6*	*5*	*0*	*5*				*0.000195*	*0.00024*	*0.000026*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Vinyl Chloride	*75-01-4*	*5*	*0*	*5*				*0.000055*	*0.00009*	*0.000015*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Xylene, Total	1330-20-7	1	0	1				0.00095	0.00095	0.21	TapWater			Not detected and not greater than RBC
cis-1,2-Dichloroethene	156-59-2	4	0	4				0.000405	0.000415	0.061	TapWater			Not detected and not greater than RBC
trans-1,2-Dichloroethene	156-60-5	4	0	4				0.0004	0.000445	0.12	TapWater			Not detected and not greater than RBC
trans-1,3-Dichloropropene	10061-02-6	10	0	10				0.000095	0.00032	0.00044	TapWater			Not detected and not greater than RBC
Xylene, o	95-47-6	4	0	4				0.000365	0.000415	0.21	TapWater			Not detected and not greater than RBC
Xylenes, m + p	108-38-3	4	0	4				0.00055	0.0009	0.21	TapWater			Not detected and not greater than RBC

a - Comparison value based upon Ill Std. - Illinois EPA standard and TapWater - EPA Region 3 risk-based concentration for tap water.

b - COPC indicates Constituent of Potential Concern.

Table 6
Summary of COPC Selection Process
SURFACE WATER (Units mg/liter)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
Calcium	7440-70-2	11	11	0	100%	42	150			NA				
Magnesium	7439-95-4	11	11	0	100%	12	38			NA				
Potassium	9/7/7440	11	11	0	100%	3.6	17			NA				
Sodium	7440-23-5	11	11	0	100%	15	62			NA				
Sulfate	14808-79-8	11	11	0	100%	21	450			500	Ill. Std			Det. Freq > 5% but RBC not exceeded
Aluminum	7429-90-5	11	6	5	55%	0.031	0.21	0.0135	0.0135	37	TapWater			Det. Freq > 5% but RBC not exceeded
Antimony	7440-36-0	11	0	11				0.00125	0.00125	0.015	TapWater			Not detected and not greater than RBC
Arsenic	*7440-38-2*	*11*	*0*	*11*				*0.00405*	*0.00405*	*0.000045*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Barium	7440-39-3	11	11	0	100%	0.021	0.14			2.6	TapWater			Det. Freq > 5% but RBC not exceeded
Beryllium	7440-41-7	11	0	11				0.000305	0.000305	0.073	TapWater			Not detected and not greater than RBC
Cadmium	7440-43-9	11	9	2	82%	0.0023	0.23	0.000265	0.000265	0.018	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Chromium	16065-83-1	11	2	9	18%	0.001	0.0011	0.000465	0.000465	0.11	TapWater			Det. Freq > 5% but RBC not exceeded
Cobalt	7440-48-4	11	5	6	45%	0.00092	0.0044	0.00045	0.00045	0.73	TapWater			Det. Freq > 5% but RBC not exceeded
Copper	7440-50-8	11	11	0	100%	0.0011	0.0059			1.5	TapWater			Det. Freq > 5% but RBC not exceeded
Iron	7439-89-6	11	11	0	100%	0.056	15			11	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Lead	7439-92-1	11	4	7	36%	0.0022	0.0032	0.00065	0.00065	0.015	TapWater			Det. Freq > 5% but RBC not exceeded
Manganese	7439-96-5	11	11	0	100%	0.01	0.62			0.73	TapWater			Det. Freq > 5% but RBC not exceeded
Mercury	7439-97-6/	11	1	10	9%	0.000034	0.000034	0.000014	0.000014	0.011	TapWater			Det. Freq > 5% but RBC not exceeded
Nickel	7440-02-0	11	11	0	100%	0.0018	0.036			0.73	TapWater			Det. Freq > 5% but RBC not exceeded
Selenium	7782-49-2	11	0	11				0.0024	0.0024	0.18	TapWater			Not detected and not greater than RBC
Silver	7440-22-4	11	0	11				0.00055	0.00055	0.18	TapWater			Not detected and not greater than RBC
Thallium	7791-12-0	11	0	11				0.00215	0.00215	0.0029	TapWater			Not detected and not greater than RBC
Vanadium	7440-62-2	11	2	9	18%	0.00087	0.0015	0.00042	0.00042	0.011	TapWater			Det. Freq > 5% but RBC not exceeded
Zinc	7440-66-6	11	11	0	100%	0.84	26			11	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Aroclor 1016	12674-11-2	11	0	11				0.00048	0.00055	0.00096	TapWater			Not detected and not greater than RBC
Aroclor 1221	*11104-28-2*	*11*	*0*	*11*				*0.00048*	*0.00055*	*0.000033*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Aroclor 1232	*11141-16-5*	*11*	*0*	*11*				*0.00048*	*0.00055*	*0.000033*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Aroclor 1242	*53469-21-9*	*11*	*0*	*11*				*0.00048*	*0.00055*	*0.000033*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Aroclor 1248	*12672-29-6*	*11*	*0*	*11*				*0.00048*	*0.00055*	*0.000033*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Aroclor 1254	*11097-69-1*	*11*	*0*	*11*				*0.00048*	*0.00055*	*0.000033*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Aroclor 1260	*11096-82-5*	*11*	*0*	*11*				*0.00048*	*0.00055*	*0.000033*	*TapWater*		*Yes*	*Not detected but greater than RBC*
2,2'-oxybis(1-Chloropropane)	*108-60-1*	*7*	*0*	*7*				*0.0018*	*0.0018*	*0.00026*	*TapWater*		*Yes*	*Not detected but greater than RBC*
2,4,5-Trichlorophenol	95-95-4	7	0	7				0.0023	0.0023	3.7	TapWater			Not detected and not greater than RBC
2,4,6-Trichlorophenol	88-06-2	7	0	7				0.002	0.002	0.0061	TapWater			Not detected and not greater than RBC
2,4-Dichlorophenol	120-83-2	7	0	7				0.00185	0.00185	0.11	TapWater			Not detected and not greater than RBC
2,4-Dimethylphenol	105-67-9	7	0	7				0.00145	0.00145	0.73	TapWater			Not detected and not greater than RBC

Table 6
Summary of COPC Selection Process
SURFACE WATER (Units mg/liter)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
2,4-Dinitrophenol	51-28-5	7	0	7				0.0015	0.0015	0.073	TapWater			Not detected and not greater than RBC
2,4-Dinitrotoluene	121-14-2	7	0	7				0.00085	0.00085	0.073	TapWater			Not detected and not greater than RBC
2,6-Dinitrotoluene	606-20-2	7	0	7				0.00185	0.00185	0.037	TapWater			Not detected and not greater than RBC
2-Chloronaphthalene	91-58-7	7	0	7				0.0021	0.0021	0.49	TapWater			Not detected and not greater than RBC
2-Chlorophenol	95-57-8	7	0	7				0.00055	0.00055	0.03	TapWater			Not detected and not greater than RBC
2-Methylnaphthalene	91-57-6	7	0	7				0.00195	0.00195	0.12	TapWater			Not detected and not greater than RBC
2-Methylphenol	95-48-7	7	0	7				0.00115	0.00115	1.8	TapWater			Not detected and not greater than RBC
2-Nitroaniline	88-74-4	7	0	7				0.0021	0.0021	0.11	TapWater			Not detected and not greater than RBC
2-Nitrophenol	88-75-5	7	0	7				0.00185	0.00185	0.015	TapWater			Not detected and not greater than RBC
3,3-Dichlorobenzidine	*91-94-1*	*7*	*0*	*7*				*0.0014*	*0.0014*	*0.00015*	*TapWater*		*Yes*	*Not detected but greater than RBC*
3-Nitroaniline	99-09-2	7	0	7				0.0014	0.0014	0.0033	TapWater			Not detected and not greater than RBC
4,6-Dinitro-2-methylphenol	534-52-1	7	0	7				0.00085	0.00085	0.0037	TapWater			Not detected and not greater than RBC
4-Bromophenyl phenyl ether	*101-55-3*	*7*	*0*	*7*				*0.0018*	*0.0018*	*1.00E-06*	*TapWater*		*Yes*	*Not detected but greater than RBC*
4-Chloro-3-methylphenol	59-50-7	7	0	7				0.00205	0.00205	0.037	TapWater			Not detected and not greater than RBC
4-Chloroaniline	106-47-8	7	0	7				0.0021	0.0021	0.15	TapWater			Not detected and not greater than RBC
4-Chlorophenyl phenyl ether	*7005-72-3*	*7*	*0*	*7*				*0.00235*	*0.00235*	*1.00E-06*	*TapWater*		*Yes*	*Not detected but greater than RBC*
4-Methylphenol	106-44-5	7	0	7				0.001	0.001	0.18	TapWater			Not detected and not greater than RBC
4-Nitroaniline	100-01-6	7	0	7				0.0009	0.0009	0.0033	TapWater			Not detected and not greater than RBC
4-Nitrophenol	100-02-7	7	0	7				0.0009	0.0009	0.15	TapWater			Not detected and not greater than RBC
Acenaphthylene	208-96-8	14	0	14				0.0023	0.00235	0.37	TapWater			Not detected and not greater than RBC
Acetophenone	98-86-2	7	0	7				0.00225	0.00225	0.61	TapWater			Not detected and not greater than RBC
Anthracene	120-12-7	7	0	7				0.0014	0.0014	1.8	TapWater			Not detected and not greater than RBC
Atrazine	*1912-24-9*	*7*	*0*	*7*				*0.0011*	*0.0011*	*0.0003*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Benzaldehyde	100-52-7	7	0	7				0.0041	0.0041	3.7	TapWater			Not detected and not greater than RBC
Benzo(a)anthracene	*56-55-3*	*7*	*0*	*7*				*0.00085*	*0.00085*	*0.000092*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Benzo(a)pyrene	*50-32-8*	*7*	*0*	*7*				*0.00075*	*0.00075*	*9.20E-06*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Benzo(b)fluoranthene	*205-99-2*	*7*	*0*	*7*				*0.0011*	*0.0011*	*0.000092*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Benzo(k)fluoranthene	*207-08-9*	*7*	*0*	*7*				*0.0012*	*0.0012*	*0.00092*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Biphenyl	92-52-4	7	0	7				0.00265	0.00265	0.3	TapWater			Not detected and not greater than RBC
Butylbenzylphthalate	85-68-7	7	0	7				0.0009	0.0009	7.3	TapWater			Not detected and not greater than RBC
Caprolactam	105-60-2	7	0	7				0.00065	0.00065	18	TapWater			Not detected and not greater than RBC
Carbazole	86-74-8	7	0	7				0.0007	0.0007	0.0033	TapWater			Not detected and not greater than RBC
Chrysene	218-01-9	7	0	7				0.0009	0.0009	0.0092	TapWater			Not detected and not greater than RBC
Di-n-butylphthalate	84-74-2	7	0	7				0.0007	0.0007	3.7	TapWater			Not detected and not greater than RBC
Di-n-octylphthalate	117-84-0	7	0	7				0.00065	0.00065	1.5	TapWater			Not detected and not greater than RBC
Dibenzo(a,h)anthracene	*53-70-3*	*7*	*0*	*7*				*0.0012*	*0.0012*	*9.20E-06*	*TapWater*		*Yes*	*Not detected but greater than RBC*

Table 6
Summary of COPC Selection Process
SURFACE WATER (Units mg/liter)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
Dibenzofuran	132-64-9	7	0	7				0.00235	0.00235	0.012	TapWater			Not detected and not greater than RBC
Diethylphthalate	84-66-2	7	0	7				0.00135	0.00135	29	TapWater			Not detected and not greater than RBC
Dimethylphthalate	131-11-3	7	0	7				0.00175	0.00175	370	TapWater			Not detected and not greater than RBC
Fluoranthene	206-44-0	7	0	7				0.0008	0.0008	1.5	TapWater			Not detected and not greater than RBC
Fluorene	86-73-7	7	0	7				0.00235	0.00235	0.24	TapWater			Not detected and not greater than RBC
Hexachlorobenzene	*118-74-1*	*7*	*0*	*7*				*0.0007*	*0.0007*	*0.000042*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Hexachlorobutadiene	*87-68-3*	*7*	*0*	*7*				*0.00145*	*0.00145*	*0.00086*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Hexachlorocyclopentadiene	77-47-4	7	0	7				0.0007	0.0007	0.22	TapWater			Not detected and not greater than RBC
Hexachloroethane	67-72-1	7	0	7				0.00115	0.00115	0.0048	TapWater			Not detected and not greater than RBC
Indeno(1,2,3-cd)pyrene	*193-39-5*	*7*	*0*	*7*				*0.0008*	*0.0008*	*0.000092*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Isophorone	78-59-1	7	0	7				0.00225	0.00225	0.07	TapWater			Not detected and not greater than RBC
N-Nitroso-di-n-propylamine	*621-64-7*	*7*	*0*	*7*				*0.00215*	*0.00215*	*9.60E-06*	*TapWater*		*Yes*	*Not detected but greater than RBC*
N-Nitrosodiphenylamine	86-30-6	7	0	7				0.0011	0.0011	0.014	TapWater			Not detected and not greater than RBC
Naphthalene	91-20-3	7	0	7				0.0019	0.0019	0.0065	TapWater			Not detected and not greater than RBC
Nitrobenzene	98-95-3	7	0	7				0.00175	0.00175	0.0035	TapWater			Not detected and not greater than RBC
Pentachlorophenol	87-86-5	7	0	7				0.00039	0.00039	0.00056	TapWater			Not detected and not greater than RBC
Phenol	108-95-2	7	0	7				0.0005	0.0005	11	TapWater			Not detected and not greater than RBC
Pyrene	129-00-0	21	0	21				0.0009	0.00105	0.18	TapWater			Not detected and not greater than RBC
bis(2-Chloroethoxy)methane	*111-91-1*	*7*	*0*	*7*				*0.00225*	*0.00225*	*0.00001*	*TapWater*		*Yes*	*Not detected but greater than RBC*
bis(2-Chloroethyl)ether	*111-44-4*	*7*	*0*	*7*				*0.000435*	*0.000435*	*9.60E-06*	*TapWater*		*Yes*	*Not detected but greater than RBC*
bis(2-Ethylhexyl)phthalate	117-81-7	7	0	7				0.0007	0.0007	0.0048	TapWater			Not detected and not greater than RBC
1,1,1-Trichloroethane	71-55-6	12	0	12				0.000325	0.00045	3.2	TapWater			Not detected and not greater than RBC
1,1,2,2-Tetrachloroethane	*79-34-5*	*12*	*0*	*12*				*0.0001*	*0.000385*	*0.000053*	*TapWater*		*Yes*	*Not detected but greater than RBC*
1,1,2-Trichloroethane	*79-00-5*	*12*	*0*	*12*				*0.00021*	*0.00025*	*0.00019*	*TapWater*		*Yes*	*Not detected but greater than RBC*
1,1,2-Trichlorotrifluoroethane	76-13-1	12	0	12				0.00027	0.000465	59	TapWater			Not detected and not greater than RBC
1,1-Dichloroethane	75-34-3	12	0	12				0.000375	0.000435	0.8	TapWater			Not detected and not greater than RBC
1,1-Dichloroethene	75-35-4	12	0	12				0.00028	0.000285	0.35	TapWater			Not detected and not greater than RBC
1,2,4-Trichlorobenzene	120-82-1	19	0	19				0.000285	0.0015	0.0072	TapWater			Not detected and not greater than RBC
1,2-Dibromo-3-chloropropane	*96-12-8*	*12*	*0*	*12*				*0.000435*	*0.00044*	*0.000047*	*TapWater*		*Yes*	*Not detected but greater than RBC*
1,2-Dibromoethane	*106-93-4*	*12*	*0*	*12*				*0.00028*	*0.00033*	*7.50E-07*	*TapWater*		*Yes*	*Not detected but greater than RBC*
1,2-Dichlorobenzene	95-50-1	19	0	19				0.000355	0.00125	0.27	TapWater			Not detected and not greater than RBC
1,2-Dichloroethane	*107-06-2*	*12*	*0*	*12*				*0.00018*	*0.000275*	*0.00012*	*TapWater*		*Yes*	*Not detected but greater than RBC*
1,2-Dichloropropane	*78-87-5*	*12*	*0*	*12*				*0.000195*	*0.00023*	*0.00016*	*TapWater*		*Yes*	*Not detected but greater than RBC*
1,3-Dichlorobenzene	541-73-1	19	0	19				0.00029	0.00115	0.18	TapWater			Not detected and not greater than RBC
1,4-Dichlorobenzene	*106-46-7*	*19*	*0*	*19*				*0.000315*	*0.00115*	*0.00047*	*TapWater*		*Yes*	*Not detected but greater than RBC*
2-Butanone	78-93-3	12	7	5	58%	0.004	0.004	0.00215	0.00215	7	TapWater			Det. Freq > 5% but RBC not exceeded

Table 6
Summary of COPC Selection Process
SURFACE WATER (Units mg/liter)
Human Health Risk Assessment for the Eagle Zinc Company Site
Hillsboro, Illinois

Compound	CAS	Samples			Frequency of	Detected Concentration		Detection Limits		Comparison RBC		COPC[b]	Address in	Rationale
		#	DT	ND	Detection	Min	Max	Min	Max	Value	Note[a]		Uncertainty	
2-Hexanone	591-78-6	12	0	12				0.00055	0.0006	0.44	TapWater			Not detected and not greater than RBC
4-Methyl-2-pentanone	108-10-1	12	0	12				0.000455	0.0006	0.58	TapWater			Not detected and not greater than RBC
Acetone	67-64-1	12	7	5	58%	0.0033	0.0033	0.0011	0.0011	5.5	TapWater			Det. Freq > 5% but RBC not exceeded
Benzene	71-43-2	12	0	12				0.000125	0.000205	0.00034	TapWater			Not detected and not greater than RBC
Bromodichloromethane	*75-27-4*	*12*	*0*	*12*				*0.000115*	*0.00028*	*0.00017*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Bromoform	75-25-2	12	0	12				0.000225	0.00047	0.0085	TapWater			Not detected and not greater than RBC
Bromomethane	74-83-9	12	0	12				0.000435	0.000455	0.0085	TapWater			Not detected and not greater than RBC
Carbon Disulfide	75-15-0	12	0	12				0.00025	0.00033	1	TapWater			Not detected and not greater than RBC
Carbon Tetrachloride	*56-23-5*	*12*	*0*	*12*				*0.000235*	*0.000245*	*0.00016*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Chlorobenzene	108-90-7	12	0	12				0.000205	0.00029	0.11	TapWater			Not detected and not greater than RBC
Chlorodibromomethane	*124-48-1*	*12*	*0*	*12*				*0.000405*	*0.00042*	*0.00013*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Chloroethane	75-00-3	12	0	12				0.00042	0.000485	0.0036	TapWater			Not detected and not greater than RBC
Chloroform	*67-66-3*	*12*	*0*	*12*				*0.000185*	*0.000225*	*0.00015*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Chloromethane	74-87-3	12	0	12				0.00012	0.000135	0.0008	TapWater			Not detected and not greater than RBC
Cyclohexane	110-82-7	12	0	12				0.000445	0.0006	36.5	TapWater			Not detected and not greater than RBC
Dichlorodifluoromethane	75-71-8	12	0	12				0.000285	0.000495	0.35	TapWater			Not detected and not greater than RBC
Ethylbenzene	100-41-4	12	0	12				0.000265	0.00027	1.3	TapWater			Not detected and not greater than RBC
Fluorotrichloromethane	75-69-4	12	0	12				0.000395	0.000425	1.3	TapWater			Not detected and not greater than RBC
Isopropylbenzene	98-82-8	12	0	12				0.000295	0.00033	0.66	TapWater			Not detected and not greater than RBC
Methyl Acetate	79-20-9	12	0	12				0.00095	0.00105	6.1	TapWater			Not detected and not greater than RBC
Methyl-tert-butyl-ether	1634-04-4	12	0	12				0.000305	0.000435	0.0026	TapWater			Not detected and not greater than RBC
Methylcyclohexane	108-87-2	12	0	12				0.000365	0.00095	36.5	TapWater			Not detected and not greater than RBC
Methylene Chloride	75-09-2	12	0	12				0.000215	0.000235	0.0041	TapWater			Not detected and not greater than RBC
Styrene	100-42-5	12	0	12				0.00031	0.00043	1.6	TapWater			Not detected and not greater than RBC
Tetrachloroethene	*127-18-4*	*12*	*0*	*12*				*0.000225*	*0.000315*	*0.0001*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Toluene	108-88-3	12	0	12				0.000335	0.00042	0.75	TapWater			Not detected and not greater than RBC
Trichloroethylene	79-01-6	12	7	5	58%	0.0014	0.0063	0.000195	0.000195	0.000026	TapWater	Yes		Det. Freq > 5% and exceeds RBC
Vinyl Chloride	*75-01-4*	*12*	*0*	*12*				*0.000055*	*0.00009*	*0.000015*	*TapWater*		*Yes*	*Not detected but greater than RBC*
Xylene, o	95-47-6	12	0	12				0.000365	0.000415	0.21	TapWater			Not detected and not greater than RBC
Xylenes, m + p	108-38-3	12	0	12				0.00055	0.0009	0.21	TapWater			Not detected and not greater than RBC
cis-1,2-Dichloroethene	156-59-2	12	7	5	58%	0.0011	0.0022	0.000405	0.000405	0.061	TapWater			Det. Freq > 5% but RBC not exceeded
trans-1,2-Dichloroethene	156-60-5	12	0	12				0.0004	0.000445	0.12	TapWater			Not detected and not greater than RBC
trans-1,3-Dichloropropene	10061-02-6	24	0	24				0.000095	0.00032	0.00044	TapWater			Not detected and not greater than RBC

a - Comparison value based upon Ill Std. - Illinois EPA standard and TapWater - EPA Region 3 risk-based concentration for tap water.

b - COPC indicates Constituent of Potential Concern.

Table 7. Summary of Chemicals of Potential Concern in Site Media
Eagle Zinc Company Site

Soil	Sediment	Groundwater	Surface Water
Arsenic	Arsenic	Sulfate	Cadmium
Cadmium	Cadmium	Aluminum	Iron
Iron	Iron	Arsenic	Zinc
Manganese	Lead	Cadmium	Trichloroethylene
Vanadium	Vanadium	Cadmium - Dissolved	
Zinc[a]	Zinc[a]	Chromium (as Cr^{+6})	
	Trichloroethylene	Iron	
		Lead	
		Lead - Dissolved	
		Manganese	
		Manganese - Dissolved	
		Thallium	
		Thallium - Dissolved	
		Vanadium	
		Zinc	
		Zinc - Dissolved	

[a] – Zinc could be eliminated as a COPC in this medium based upon the screening assessment, but was retained because it is a primary component of Site waste material.

[b] – Total chromium is conservatively assumed to be hexavalent.

Table 8. Representative Concentrations of Chemicals of Potential Concern in Site Media
Eagle Zinc Company Site

Receptor	Medium	Aluminum	Arsenic	Cadmium	Chromium	Iron	Lead	Manganese	Thallium	Vanadium	Zinc	Trichlorethylene
Commercial/Industrial	Soil[a]	NC	7.93 [13]	31.9 [87]	NC	25000 [47,000]	NC	506 [1,900]	NC	50.6 [72]	3010 [11,000]	NC
	Sediment	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Surface Water	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Construction Worker	Soil[a]	NC	7.93 [13]	31.9 [87]	NC	25000 [47,000]	NC	506 [1,900]	NC	50.6 [72]	3010 [11,000]	NC
	Sediment	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Groundwater	42.3 [110]	0.025 [0.075]	0.0748 [0.39]	0.0518 [0.17]	78.7 [210]	0.17 [0.93]	5.04 [13]	0.00477 [0.0074]	0.00617 [0.2]	96.7 [210]	NC
	Surface Water	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Trespasser	Soil[a]	NC	7.93 [13]	31.9 [87]	NC	25000 [47,000]	NC	506 [1,900]	NC	50.6 [72]	3010 [11,000]	NC
	Sediment	NC	25	550	NC	45,000	2,700	NC	NC	34	23,000	13
	Surface Water	NC	NC	0.23	NC	15	NC	NC	NC	NC	26	0.0063
Recreational	Soil	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Sediment[b]	NC	3.2*	8.9*	NC	8500.0*	87.0*	NC	NC	15.0*	8400.0*	0.0012
	Surface Water[b]	NC	NC	0.00053*	NC	0.23*	NC	NC	NC	NC	0.84*	0.00039*
Adult Resident	Soil	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Sediment	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Surface Water[b]	NC	NC	0.00053	NC	0.23	NC	NC	NC	NC	0.84	0.00039
Child Resident	Soil	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Sediment	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Surface Water[b]	NC	NC	0.00053*	NC	0.23*	NC	NC	NC	NC	0.84*	0.00039*
Fisher	Soil	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Sediment	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Surface Water[b]	NC	NC	0.00053*	NC	0.23*	NC	NC	NC	NC	0.84*	0.00039*

Units are mg/kg for soil and sediment and mg/liter for surface water.

NC = not a COPC in medium.

[a] - Soil and groundwater values listed are 95% UCL with maximum detected concentration in brackets.

[b] - Representative concentrations in sediment and surface water for these receptors are from samples SD-ED-16 and SW-ED-16, respectively.

[*] - Representative concentrations do not exceed respective COPC screening criteria in sediment and surface water (Tables 4 and 6, respectively). Nonetheless, they are used to conservatively estimate exposure to receptors in Lake Hillsboro.

Table 9. Exposure Parameter Values Used to Calculate Tier 1 Levels for On-Site Commercial/Industrial Workers
Eagle Zinc Company Site

Exposure Routes: *Inhalation of On-Site Soil Vapors*
Inhalation of Particulates from On-Site Soil
Incidental Ingestion of On-Site Soil
Dermal Contact with On-Site Soil

Exposure Parameter	Variable	Units	Value	Reference and Comments
Physiological Assumptions				
Body Weight	BW	kg	70	Recommended value for adult worker from EPA (2002b). Mean body weight for an adult recommended for use in EPA (1997a), Table 7-11, Page 7-11 is 71.8 kg.
Total Skin Surface Area	SA	cm^2/event	18150	Total average surface area for adult males and adult females. Value taken from EPA (2001), Exhibit C-2, Page C-4.
Fraction of Skin Contacting Soil - (face, hands, and forearms)	FSA	unitless	0.182	EPA (2002b) indicates that area should include fraction of total skin surface area comprising the face, hands, and forearms for an average adult. However, value of 3300 cm^2, as specified in EPA (2001), is only possible using head, forearms, and hands. Following surface area values are taken from Exhibit C-1, Page C-4 of EPA (2001): head, 1206 cm^2; face, 402 cm^2; forearms, 1173 cm^2; and hands, 904 cm^2 and would represent a fraction of skin contacting soil of 0.137. For this assessment, a fraction of surface area exposed that would provide a skin surface area of 3300 cm^2 was used.
Soil Ingestion Rate	SIR	mg/day	100	Recommended value in EPA (2002b) and reflects the increased ingestion exposures experienced by outdoor workers during landscaping or other soil disturbing activies. EPA (1997a) recommends a value of 50 mg/day for adults, Table 4-23, Page 4-25.
Soil Adherence Factor	AF	mg/cm^2	0.2	Recommended value for commercial/industrial worker from EPA (2002b). Recommended value for adult provided in EPA (2001), Equation 3.21, Page 3-24 would be 0.07.
Particle Emission Factor	PEF	m^3/kg-soil	6.0E+08	Calculated per Equation 4-5 of EPA (2002b).
Exposure Duration/Frequency Assumptions				
Averaging Time for Cancer	ATc	years	70	Recommended lifespan for adult worker from EPA (2002b). Recommended average life expectancy of general population as specified in EPA (1997a), Section 8.2, Page 8-1 is 75 years.
Exposure Frequency	EF	days/yr	225	Recommended value in EPA (2002b) and assumes an 8-hour workday and is based on data from the following occupational categories in U.S. Censure Bureau's 1990 Earnings by Occupation and Education Survey: groundskeeper and gardeners, except farm; specified mechanics and repairers, not elsewhere classified; not specified mechanics and repairs; painters, construction, and maintenance, and construction laborers.
Event Frequency	EV	events/day	1	As specified in EPA (2002b), assume 1 event per day.
Exposure Duration	ED	years	25	Recommended value in EPA (2002b) and assumed to be equivalent to job tenure. Represents the 95th %tile for job tenure in manufacturing for men and is considered protective of workers across a wide spectrum of industrial and commercial sectors.
Averaging Time for Non-carcinogens	ATnc	years	=ED	Averaging time for non-carcinogens assumed to be equivalent to exposure duration for this receptor.

Table 10. Exposure Parameter Values Used to Calculate Tier 1 Levels for On-Site Construction Workers
Eagle Zinc Company Site

Exposure Routes: *Inhalation of Soil Vapors*
Inhalation of Particulates from Soil
Incidental Ingestion of Soil
Dermal Contact with Soil

Exposure Parameter	Variable	Units	Value	Reference and Comments
Physiological Assumptions				
Body Weight	BW	kg	70	Recommended value for adult worker from EPA (2002b). Mean body weight for an adult recommended for use in EPA (1997a), Table 7-11, Page 7-11 is 71.8 kg.
Total Skin Surface Area	SA	cm^2/event	18150	Total average surface area for adult males and adult females. Value taken from EPA (2002b), Exhibit C-2, Page C-4.
Fraction of Skin Contacting Soil - (face, hands, and forearms)	FSA	unitless	0.182	EPA (2002b) indicates that area should include fraction of total skin surface area comprising the face, hands, and forearms for an average adult. However, value of 3300 cm^2, as specified in EPA (2001), is only possible using head, forearms, and hands. Following surface area values are taken from Exhibit C-1, Page C-4 of EPA (2001): head, 1206 cm^2; face, 402 cm^2; forearms, 1173 cm^2; and hands, 904 cm^2 and would represent a fraction of skin contacting soil of 0.137. For this assessment, a fraction of surface area exposed that would provide a skin surface area of 3300 cm^2 was used.
Fraction of Skin Contacting Surface Water	FSA_{SW}	unitless	0.1144	Exhibit C-1, Page C-4 of EPA (200l) indicates average surface area for forearms and hands of 1173 cm^2 and 904 cm^2.
Soil Ingestion Rate	SIR	mg/day	330	Recommended value in EPA (2002b) and reflects the high-end soil ingestion rate based upon the 95th percentile value for adult soil intake rates reported in a soil ingestion mass-balance study by Stanek et al. (1997). The typical outdoor industrial/commercial worker is assumed to ingest 100 mg/day per EPA (1997a) and an indoor worker 50 mg/day per EPA (2002b).
Soil Adherence Factor	AF	mg/cm^2	0.3	Recommended value for construction worker from EPA (2002b) and represents the 95th percentile value.
Particle Emission Factor	PEF	m^3/kg-soil	6.0E+08	Calculated per Equation 5-5 of EPA (2002b).
Exposure Duration/Frequency Assumptions				
Averaging Time for Cancer	ATc	years	70	Recommended lifespan for adult worker from EPA (2002b). Recommended average life expectancy of general population as specified in EPA (1997a), Section 8.2, Page 8-1 is 75 years.
Exposure Frequency	EF	days/yr	30	Value of 30 days per year was obtained from Table D of Appendix C of Illinois's Title 35: Subtitle G: Chapter I: Subchapter f: Part 742. Value of 250 days/year indicated in EPA (2002b) as default value with no defined basis. Guidance indicates to use site-specific data for this parameter if available.
Event Frequency	EV	events/day	1	As specified in EPA (2002b), assume 1 event per day.
Exposure Duration	ED	years	1	Value of 1 year was obtained from the Table D of Appendix C of Illinois's Title 35: Subtitle G: Chapter I: Subchapter f: Part 742. Value of 1 year also specified in EPA (2002b) as default value with no defined basis. Guidance indicates to use site-specific data for this parameter.
Exposure Time to Surface Water	ETsw	hr/day	4	Conservative assumption on time receptor may come in contact with groundwater while performing construction activities. This value indicates that the construction worker would be in contact with his hands and forearms for half the time he is on the job.
Averaging Time for Non-carcinogens	ATnc	years	0.115	Averaging time for non-carcinogens as specified in Table D of Appendix C of Illinois's Title 35: Subtitle G: Chapter I: Subchapter f: Part 742. The EPA (2002b) indicates that this parameter should be set equal to the exposure duration.

Table 11. Exposure Parameter Values Used to Calculate Tier 1 Levels for Trespassers
Eagle Zinc Company Site

Exposure Routes:
Inhalation of Soil Vapors
Inhalation of Particulates from Soil
Incidental Ingestion of Soil
Dermal Contact with Soil
Incidental Ingestion of Surface Water
Dermal Contact with Surface Water
Incidental Ingestion of Sediment

Exposure Parameter	Variable	Units	Value	Reference and Comments
Physiological Assumptions				
Body Weight	BW	kg	54.4	Average of the mean body weight reported for both boys and girls combined as reported in EPA (2002a), Tables 11-2 and 11-3, Pages 11-5 and 11-6. Age categories greater than or equal to 12 and less than 18 years of age used.
Incidental Surface Water Ingestion	^{swim}WIR	L/hr	0.05	Estimated surface water intake rate while swimming (EPA 1989).
Total Skin Surface Area	SA	cm^2/event	15,200	Total average surface area for males and females greater than or equal to 12 and less then 18 years of age. Value taken from EPA (2002a), Tables 8-1 and 8-2, Pages 8-13 and 8-14.
Fraction of Skin Contacting Soil - (arms, hands, lower legs, and face)	FSA_{soil}	unitless	0.329	Average of the fraction of total surface area available for contact for child greater than or equal to 12 and less than 18 years of age assuming arms, hands, face, and lower legs are exposed. Value taken from EPA (2001), Exhibit C-1, Page C-3.
Fraction of Skin Contacting Surface Water	FSA_{SW}	unitless	1	Assume all skin in contact with surface water during swimming event.
Soil/Sediment Ingestion Rate	SIR	mg/day	50	Recommended value for adult (assumed child is 6 years old or less). Taken from EPA (1997a), Table 4-23, Page 4-25. Incidental ingestion of sediment is assumed to be equivalent to Incidental ingestion of soil.
Soil Adherence Factor	AF	mg/cm^2	0.034	Assumed exposure would be equivalent to that of Soccer No 1 values from Table 8-8 of EPA (2002a). Assumes arms, hands, face, and lower legs are exposed. Values in Table 8-8 of EPA (2002a) and Exhibit C-1 of EPA (2001) were used to estimate an overall soil adherence factor.
Particle Emission Factor	PEF	m^3/kg-soil	6.0E+08	Calculated per Equation 4-5 of EPA (2002b).
Exposure Duration/Frequency Assumptions				
Averaging Time for Cancer	ATc	years	70	Recommended lifespan from EPA (2002b). Recommended average life expectancy of general population as specified in EPA (1997a), Section 8.2, Page 8-1 is 75 years.
Exposure Frequency	EF	days/yr	12	Value based upon professional judgement. Assumes a trespasser would cross the site approximately 1 time per week during the summer months.
Event Frequency	EV	events/day	1	Assume 1 event per day.
Exposure Duration	ED	years	6	Assumes that the average trespasser onto the Site would do so between ages greater than or equal to 12 and less than 18 for an exposure duration of 6 years.
Averaging Time for Non-carcinogens	ATnc	years	=ED	Averaging time for non-carcinogens assumed to be equivalent to exposure duration for this receptor.
Contact Rate with Surface Water	CRsw	ml/hr	50	Value of 50 ml/hr contact rate (incidental ingestion of water) is listed in EPA (1997c) for swimming.
Exposure Time to Surface Water	ETsw	hr/day	1	This value is the upper bound on number of days swimming taken from Table 15-18 in EPA (1997c). The central tendency value as reported in EPA (1997c) is 0.5 hr/day.

Table 12. Exposure Parameter Values Used to Calculate Tier 1 Levels for Off-Site Recreational Bathers
Eagle Zinc Company Site

	Exposure Routes:	*Incidental Ingestion of Surface Water* *Dermal Contact with Surface Water* *Incidental Ingestion of Sediment*			
Exposure Parameter	**Variable**	**Units**	**Child**	**Adult**	**Reference and Comments**
Physiological Assumptions					
Body Weight	BW	kg	15	70	Recommended default values for adults and children (EPA 2002b).
Incidental Surface Water Ingestion R	^{swim}WIR	L/hr	0.05	0.05	Estimated surface water intake rate while swimming (EPA 1989).
Age-adjusted Incidental Surface Water Ingestion Rate (swimming)	$^{swim}WIR_{ad}$	L-yr/kg-hr	0.04		Calculated per Equation 2 (EPA Region 3 2003b).
Incidental Sediment Ingestion Rate	SedIR	mg/day	20	10	No data for incidental sediment ingestion while swimming was found. Therefore, sediment ingestion rates were conservatively estimated as one-tenth the default residential daily soil ingestion rates for children and adults (200/10=20 mg/day for child and 100/10=10 mg/day for adults)
Age-adjusted Sediment Ingestion Ra	$SedIR_{adj}$	mg-yr/kg-day	11.4		Calculated by analogy to age-adjusted soil ingestion rate calculation (EPA 1991a, Equation 3).
Total Skin Surface Area	SA	cm^2/day	6,600	18,000	Recommended RME values for swimming (EPA 2001).
Fraction of Skin Contacting Surface Water	FSA	unitless	1	1	Assume all skin in contact with surface water during swimming activities
Age-adjusted Body Surface Area	SAF_{adj}	cm^2-yr/kg	8,811		Calculated per Equation 3-5 (EPA 2002b).
Exposure Duration/Frequency Assumptions					
Averaging Time for Cancer	ATc	years	70	70	Recommended lifespan from EPA (2002b). Recommended average life expectancy of general population as specified in EPA (1997a), Section 8.2, Page 8-1 is 75 years.
Exposure Frequency	EF	days/yr	24	24	Recommended frequency for swimming in pools is once per month (12 days/yr). For outdoor recreation in Illinois, a frequency of twice per week during the 12 weeks of summer (24 swimming events per year) is conservatively assumed.
Exposure Duration	ED	years	6	24	Assumes that the most likely off-Site recreational receptor contacting the surface water bodies would be adolescents between the ages greater than or equal to 6 and less than 18 for an exposure duration of 12 years.
Averaging Time for Non-carcinogens	ATnc	years	=ED	=ED	Averaging time for non-carcinogens assumed to be equivalent to exposure duration for this receptor.
Exposure Time to Surface Water	ETsw	hr/day	1	1	This value is the upper bound on number of days swimming taken from Table 15-18 in EPA (1997c) with a central tendency value of 0.5 hr/day. The 50th percentile specified in EPA (2002a) for swimming is also 1 hour per day with a 90th percentile of 3 hr/day. This number refers to time swimming at a swimming pool not necessarily at a lake.

Table 13. Exposure Parameter Values Used to Calculate Tier 1 Levels for Off-Site Residents (Child and Adult)
Eagle Zinc Company Site

Exposure Routes: *Ingestion of Potable Surface Water*
Dermal Contact with Potable Surface Water

Exposure Parameter	Variable	Units	Child	Adult	Reference and Comments
Physiological Assumptions					
Body Weight	BW	kg	15	70	Recommended default values for adults and children (EPA 2002b).
Potable Water Ingestion Rate	WIR	liter/day	1	2	Standard default values for adults and children (EPA Region 3 2003b).
Age-adjusted Water Ingestion Rate	WIR_{adj}	L-yr/kg-day	1.1		Calculated per Equation 2 (EPA Region 3 2003b).
Total Skin Surface Area	SA	cm^2/day	6,600	18,000	Recommended RME values for bathing (EPA 2001).
Fraction of Skin Contacting Surface Water	FSA	unitless	1	1	Assume all skin in contact with surface water during swimming activities
Age-adjusted Body Surface Area	SAF_{adj}	cm^2-yr/kg	8,811		Calculated per Equation 3-5 (EPA 2002b).
Exposure Duration/Frequency Assumptions					
Averaging Time for Cancer	ATc	years	70	70	Recommended lifespan from EPA (2002b). Recommended average life expectancy of general population as specified in EPA (1997a), Section 8.2, Page 8-1 is 75 years.
Exposure Frequency	EF	days/yr	350	350	Standard default values for residents (EPA Region 3 2003b).
Exposure Duration	ED	years	6	24	Standard default values for adults and children (EPA Region 3 2003b).
Averaging Time for Non-carcinogens	ATnc	years	=ED	=ED	Averaging time for non-carcinogens assumed to be equivalent to exposure duration for this receptor.
Bathing duration	Etbath	hr/day	0.58	1	Recommended RME values for bathing (EPA 2001).

Table 14. Exposure Parameter Values Used to Calculate Tier 1 Levels for Fishers (Child and Adult)
Eagle Zinc Company Site

	Exposure Routes:	*Ingestion of Potable Surface Water Dermal Contact with Potable Surface Water*			
Exposure Parameter	**Variable**	**Units**	**Child**	**Adult**	**Reference and Comments**
Physiological Assumptions					
Body Weight	BW	kg	15	70	Recommended default values for adults and children (EPA 2002b).
Amound of Fish Consumed	FIR	gm/day	5.6	26	Recommended value for recreational freshwater fish consumption for children aged 1-5 (Table 3-25, EPA 2002a); recommended 95%ile value for adults consuming recreational freshwater fish (EPA 1997b).
Age-adjusted Fish Ingestion Rate	FIR_{adj}	kg-yr/kg-day	0.01		Calculated by analogy with other age-adjusted intake rates.
Exposure Duration/Frequency Assumptions					
Averaging Time for Cancer	ATc	years	70	70	Recommended lifespan from EPA (2001b). Recommended average life expectancy of general population as specified in EPA (1997a), Section 8.2, Page 8-1 is 75 years.
Exposure Frequency	EF	days/yr	365	365	Fish intake rates are long-term daily averages.
Exposure Duration	ED	years	6	24	Standard default values for adults and children (EPA Region 3 2003b).
Averaging Time for Non-carcinogens	ATnc	years	=ED	=ED	Averaging time for non-carcinogens assumed to be equivalent to exposure duration for this receptor.

Table 15. Toxicity Factors
Eagle Zinc Company Site

COPC	CAS #	Class[a]	Ref[b]	SF_o (mg/kg-day)$^{-1}$	Ref[b]	RfD_o (mg/kg-day)	Ref[b]	URF ($\mu g/m^3$)$^{-1}$	Ref[b]	RfC (mg/m^3)	Ref[b]
Aluminum	742-90-5	NA	---	---	---	1.0E+00	N	---	---	---	---
Arsenic	7440-38-2	A	I	1.5E+00	I	3.0E-04	I	4.3E-03	I	---	---
						5.0E-03 (subchronic)	H				
Cadmium (food)	7440-43-9	B1	I	---	---	1.0E-03	I	1.8E-03	I	---	---
Cadmium (water)						5.0E-04	I				
Chromium (hexavalent)**	18540-29-9	A	I	---	---	3.0E-03	I	1.2E-02	I	1.0E-04	I
Iron	7439-89-6	ND	---	---	---	3.0E-01	R3RBC	---	---	---	---
Lead (inorganic)	7439-92-1	B2	I	---	---	---	---	---	---	---	---
Manganese (non-food)	7439-96-5	D	I	---	---	4.7E-02*	I	---	---	5.0E-05	I
Thallium	7791-12-0	D	I	---	---	8.0E-05	I	---	---	1.0E-04	---
Trichloroethylene	79-01-6	B2-C	W	1.1E-02	W	6.0E-03	W	1.7E-06	W	2.1E-02	W
		B1	W	2E-02 to 4E-01	D	3.0E-04	D	---	---	4.0E-02	D
Vanadium	7440-62-2	ND	---	---	---	7.0E-03	H	---	---	5.0E-05	---
Zinc	7440-66-6	D	I	---	---	3.0E-01	I	---	---	---	---

[a] - Weight of Evidence Classification:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as to human carcinogenicity

ND - Not determined

[b] Source: I - IRIS database; N - NCEA; H - HEAST; R3RBC - EPA Region 3 Risk-based Concentration Table (EPA 2003a); W - withdrawn from IRIS and HEAST; D - EPA Draft TCE Health Risk Assessment (EPA 2001b).

* Per IRIS, oral RfD for non-food sources of Mn is assumed to be equal to 1/3 of the RfD for Mn in food (EPA 2004b).

** Chromium was not speciated but is conservatively assumed to be hexavalent in this HHRA.

Table 16. Chemical/Physical Properties of Chemicals of Potential Concern
Eagle Zinc Company Site

COPC	CAS #	Physical State	MW^1 (g/mole)	$H_{unitless}{}^1$ (unitless)	$LogK_{oc}{}^1$ (unitless)	$LogK_d{}^1$ (unitless)	$D_{air}{}^1$ (cm^2/s)	$D_{wat}{}^1$ (cm2/s)	S^1 (mg/l)	Vapor_P[1] (mm Hg)	$logK_{ow}{}^1$ (unitless)	$K_p{}^2$ (cm/hr)	$tau_{event}{}^2$ hr/event	FA^2	$ABS_{gi}{}^1$ (unitless)	$ABS_d{}^1$ (unitless)	BCF^3 L/kg
Aluminum	742-90-5	s	2.70E+01	---	---	2.55E+00	---	---	---	---	3.29E-01	1.0E-03	---	---	1.00E-01	1.00E-02	NA
Arsenic	7440-38-2	s	7.49E+01	---	---	1.46E+00	---	---	---	---	6.79E-01	---	---	---	9.5E-01	3.0E-02	NA
Cadmium	7440-43-9	s	1.12E+02	---	---	1.88E+00	---	---	---	---	-7.10E-02	1.0E-03	---	---	2.5E-02	1.0E-03	50
Chromium	18540-29-9	s	5.20E+01	---	---	1.15E+00	---	---	---	---	---	1.0E-03	---	---	2.5E-02	1.0E-02	NA
Iron	7439-89-6	s	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1
Lead (inorganic)	7439-92-1	s	2.07E+02	---	---	1.00E+00	---	---	---	---	7.29E-01	---	---	---	1.5E-01	1.0E-02	NA
Manganese	7439-96-5	s	5.49E+01	---	---	1.70E+00	---	---	---	---	---	---	---	---	6.0E-02	1.0E-02	NA
Thallium	7791-12-0	s	2.40E+02	---	---	1.64E+00	---	---	2.90E+03	---	---	1.0E-03	---	---	1.0E+00	1.0E-02	NA
Trichloroethylene	79-01-6	l	1.31E+02	4.28E-01	1.97E+00	---	7.90E-02	9.10E-06	1.1E+03	7.2E+01	2.47E+00	1.2E-02	0.58	1	1.0E+00	---	17
Vanadium	7440-62-2	s	5.09E+01	---	---	3.00E+00	---	---	---	---	---	---	---	---	2.6E-02	1.0E-02	NA
Zinc	7440-66-6	s	6.54E+01	---	---	1.79E+00	---	---	---	---	-4.71E-01	6.0E-04	---	---	2.0E-01	1.0E-02	1000

1 - Data for these parameters were obtained from TCEQ (2004).
2 - Data for these parameters were obtained from EPA (2001a).
3 - Data for this parameter was obtained from *Protocol Bioaccumulation and Bioconcentration Screening*, Savannah River Site, Environmental Restoration Division. Manual ERD-AG-003, April 6, 1999.
NA - Not applicable.

Table 17. Summary of Tier 1 Screening Levels (mg/kg) for the On-Site Commercial/Industrial Worker Receptor
Eagle Zinc Company Site

COPC	CAS	Soil Exposure through							
		Ingestion		Dermal Contact		Particle Inhalation		Ingestion & Dermal Contact	
		Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen
Arsenic	7440-38-2	2.1E+00	3.4E+02	1.1E+01	1.7E+03	6.4E+02	---	1.8E+00	2.8E+02
Cadmium	7440-43-9	---	1.1E+03	---	4.3E+03	1.5E+03	---	---	8.8E+02
Iron	7439-89-6	---	3.4E+05	---	---	---	---	---	3.4E+05
Manganese	7439-96-5	---	5.4E+04	---	4.7E+04	---	4.9E+04	---	2.5E+04
Vanadium	7440-62-2	---	7.9E+03	---	3.1E+03	---	4.9E+04	---	2.2E+03
Zinc	7440-66-6	---	3.4E+05	---	1.0E+06	---	---	---	2.5E+05

Table 18. Summary of Tier 1 Screening Levels for the On-Site Construction Worker Receptor[a]
Eagle Zinc Company Site

COPC	CAS	Soil Exposure through								Groundwater Exposure through Dermal Contact	
		Ingestion		Dermal Contact		Inhalation		Ingestion & Dermal Contact			
		Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen
Aluminum	7429-90-5	---	---	---	---	---	---	---	---	---	1.2E+04
Arsenic	7440-38-2	1.2E+02	1.5E+03	1.3E+03	1.6E+04	1.2E+05	---	1.1E+02	1.4E+03	4.8E+00	5.9E+01
Cadmium	7440-43-9	---	3.0E+02	---	2.5E+03	2.9E+05	---	---	2.7E+02	---	5.9E+00
Chromium	18540-29-9	---	---	---	---	---	---	---	---	---	3.5E+01
Iron	7439-89-6	---	8.9E+04	---	---	---	---	---	8.9E+04	---	3.5E+03
Manganese	7439-96-5	---	1.4E+04	---	2.8E+04	---	4.3E+04	---	9.4E+03	---	1.7E+03
Thallium	7791-12-0	---	---	---	---	---	---	---	---	---	9.4E-01
Vanadium	7440-62-2	---	2.1E+03	---	1.8E+03	---	4.3E+04	---	9.7E+02	---	8.3E+01
Zinc	7440-66-6	---	8.9E+04	---	5.9E+05	---	---	---	7.7E+04	---	5.9E+03

a - Soil screening level in units of mg/kg, groundwater screening level in units of mg/L.

Table 19. Summary of Tier 1 Screening Levels for the Trespasser Receptor[a]
Eagle Zinc Company Site

COPC	CAS	Soil Exposure through								Sediment		Surface Water Exposure through					
		Incidental Ingestion		Dermal Contact		Inhalation		Ingestion & Dermal		Ingestion		Ingestion		Dermal Contact		Ingestion & Dermal	
		Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen
Arsenic	7440-38-	2.6E+02	9.9E+03	2.5E+03	9.7E+04	5.0E+04	---	2.4E+02	9.0E+03	2.6E+02	9.9E+03	NC	NC	NC	NC	NC	NC
Cadmium	7440-43-	---	3.3E+04	---	2.4E+05	1.2E+05	---	---	2.9E+04	---	3.3E+04	---	3.3E+01	---	1.1E+02	---	2.5E+01
Iron	7439-89-	---	1.0E+06	---	---	---	---	---	1.0E+06	---	1.0E+06	---	9.9E+03	---	---	---	9.9E+03
Manganese	7439-96-	---	1.0E+06	---	1.0E+06	---	9.3E+05	---	5.0E+05	NC	NC	NC	NC	NC	NC	NC	NC
Trichloroethylene (W)[b]	79-01-6	NC	NC	NC	NC	NC	NC	NC	NC	3.5E+04	2.0E+05	3.5E+01	2.0E+02	4.7E+00	2.7E+01	4.1E+00	2.4E+01
Trichloroethylene (D)[c]	79-01-6	NC	NC	NC	NC	NC	NC	NC	NC	1.9E+04 to 9.7E+02	9.9E+03	1.9E+01 to 9.7E-01	9.9E+00	2.6E+00 to 1.3E-01	1.3E+00	2.3E+00 to 1.1E-01	1.1E+00
Vanadium	7440-62-	---	2.3E+05	---	1.8E+05	---	9.3E+05	---	1.0E+05	---	2.3E+05	NC	NC	NC	NC	NC	NC
Zinc	7440-66-	---	1.0E+06	---	1.0E+06	---	---	---	5.0E+05	---	1.0E+06	---	9.9E+03	---	5.6E+04	---	8.4E+03

a - *Screening level for surface water in units of mg/L, screening level for soil and sediment in units of mg/kg.*
b - Calculations based on withdrawn toxicity criteria for trichloroethylene (W) (see Table 15)
c - Calculations based on proposed draft toxicity criteria for trichloroethylene (D) (see Table 15)
NC = not a COPC in medium.

Table 20. Summary of Tier 1 Screening Levels for the Off-Site Recreational Bather[a]
Eagle Zinc Company Site

COPC	CAS	Surface Water Exposure through						Sediment Exposure through	
		Incidental Ingestion		Dermal Contact		Ingestion & Dermal Contact		Incidental Ingestion	
		Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen
Arsenic	7440-38-2	---	---	---	---	---	---	6.2E+01	1.2E+04
Cadmium	7440-43-9	---	1.2E+01	---	4.7E+01	---	9.6E+00	---	4.0E+04
Iron	7439-89-6	---	3.7E+03	---	---	---	3.7E+03	---	1.2E+07
Trichloroethylene (W)[b]	79-01-6	2.6E+06	7.4E+01	3.9E-01	1.1E+01	3.9E-01	9.6E+00	8.5E+03	2.4E+05
Trichloroethylene (D)[c]	79-01-6	1.4E+06 to 7.2E+04	3.4E+00	2.4E-01 to 1.2E-02	6.2E-01	2.4E-01 to 1.2E-02	2.3E+02	4.7E+03 to 1.2E+04	2.3E+02
Vanadium	7440-62-2	NC	NC	NC	NC	NC	NC	---	2.8E+05
Zinc	7440-66-6	---	3.7E+03	---	2.3E+04	---	3.2E+03	---	1.2E+07

a - Screening level for surface water in units of mg/L, screening level for sediment in units of mg/kg.

b - Calculations based on withdrawn toxicity criteria for trichloroethylene (W) (see Table 15)

c - Calculations based on proposed draft toxicity criteria for trichloroethylene (D) (see Table 15)

--- = Not a COPC

NC = not a COPC in medium.

Table 21. Summary of Tier 1 Screening Levels for the Off-Site Resident Receptor (mg/L)
Eagle Zinc Company Site

COPC	CAS	Surface Water (as a potable source) Exposure through					
		Ingestion		Dermal Contact		Ingestion & Dermal Contact	
		Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen	Carcinogen	Non-Carcinogen
Cadmium	7440-43-9	---	2.9E-02	---	6.1E+00	---	2.9E-02
Iron	7439-89-6	---	8.6E+00	---	---	---	8.6E+00
Zinc	7440-66-6	---	8.6E+00	---	3.1E+03	---	8.6E+00
Trichloroethylene (W)[a]	79-01-6	6.1E-03	1.7E-01	3.9E-02	1.1E+00	5.3E-03	1.5E-01
Trichloroethylene (D)[b]	79-01-6	3.4E-03 to 1.7E-04	8.6E-03	2.2E-02 to 1.1E-03	5.5E-02	2.9E-03 to 1.5E-04	7.5E-03

a - Calculations based on withdrawn toxicity criteria for trichloroethylene (W) (see Table 15)

b - Calculations based on proposed draft toxicity criteria for trichloroethylene (D) (see Table 15)

Table 22. Summary of Tier 1 Screening Levels for the Off-Site Fisher Receptor (mg/L)
Eagle Zinc Company Site

COPC	CAS	Exposure through Ingestion of Fish	
		Carcinogen	Non-Carcinogen
Cadmium	7440-43-9	---	6.0E-02
Iron	7439-89-6	---	9.0E+02
Zinc	7440-66-6	---	9.0E-01
Trichloroethylene (W)[a]	79-01-6	3.7E-02	1.1E+00
Trichloroethylene (D)[b]	79-01-6	2.1E-02 to 1.0E-03	5.3E-02

a - Calculations based on withdrawn toxicity criteria for trichloroethylene (W) (see Table 15)

b - Calculations based on proposed draft toxicity criteria for trichloroethylene (D) (see Table 15)

Table 23. Summary of Tier 1 Incremental Lifetime Risks and Hazards for the On-Site Commercial/Industrial Worker Receptor
Eagle Zinc Company Site

COPC	CAS	Concentration	Soil Exposure through			
			Ingestion	Dermal Contact	Inhalation	Total
Estimated Incremental Lifetime Cancer Risk						
Arsenic	7440-38-2	7.93E+00	3.74E-06	7.41E-07	1.23E-08	4.49E-06
Cadmium	7440-43-9	3.19E+01	---	---	2.08E-08	2.08E-08
Iron	7439-89-6	2.50E+04	---	---	---	---
Manganese	7439-96-5	5.06E+02	---	---	---	---
Vanadium	7440-62-2	5.06E+01	---	---	---	---
Zinc	7440-66-6	3.01E+03	---	---	---	---
		TOTAL	**4E-06**	**7E-07**	**3E-08**	**5E-06**
Estimated Non-carcinogenic Hazard						
Arsenic	7440-38-2	7.93E+00	2.30E-02	4.60E-03	---	2.76E-02
Cadmium	7440-43-9	3.19E+01	2.80E-02	7.40E-03	---	3.54E-02
Iron	7439-89-6	2.50E+04	7.30E-02	---	---	7.30E-02
Manganese	7439-96-5	5.06E+02	9.53E-03	1.04E-02	1.00E-02	3.00E-02
Vanadium	7440-62-2	5.06E+01	6.40E-03	1.60E-02	1.00E-03	2.34E-02
Zinc	7440-66-6	3.01E+03	8.80E-03	2.90E-03	---	1.17E-02
		TOTAL	**1E-01**	**4E-02**	**1E-02**	**2E-01**

Table 24. Summary of Tier 1 Incremental Lifetime Risks and Hazards for the On-Site Construction Worker Receptor
Eagle Zinc Company Site

COPC	CAS	Concentration		Soil Exposure through				Groundwater	Total Over All Media
		Soil (mg/kg)	Groundwater (mg/L)	Ingestion	Dermal Contact	Inhalation	Total	Dermal Contact	
Tier 1 Incremental Lifetime Cancer Risk									
Aluminum	7429-90-5	---	4.23E+01	---	---	---	---	---	---
Arsenic	7440-38-2	7.93E+00	2.50E-02	6.58E-08	5.93E-09	6.58E-11	7.18E-08	5.20E-09	7.70E-08
Cadmium	7440-43-9	3.19E+01	7.48E-02	---	---	1.11E-10	1.11E-10		5.40E-11
Chromium	18540-29-9	---	5.18E-02	---	---	---	---	---	---
Iron	7439-89-6	2.50E+04	7.87E+01	---	---	---	---	---	---
Manganese	7439-96-5	5.06E+02	5.04E+00	---	---	---	---	---	---
Thallium	7791-12-0	---	4.77E-03	---	---	---	---	---	---
Vanadium	7440-62-2	5.06E+01	6.17E-03	---	---	---	---	---	---
Zinc	7440-66-6	3.01E+03	9.67E+01	---	---	---	---	---	---
			TOTAL	**7E-08**	**6E-09**	**2E-10**	**7E-08**	**5E-09**	**8E-08**
Tier 1 Non-carcinogenic Hazard									
Aluminum	7429-90-5	---	4.23E+01	---	---	---	---	3.50E-03	3.50E-03
Arsenic	7440-38-2	7.93E+00	2.50E-02	5.30E-03	4.80E-04	---	5.78E-03	4.20E-04	6.20E-03
Cadmium	7440-43-9	3.19E+01	7.48E-02	1.10E-01	1.30E-02	---	1.23E-01	1.30E-02	1.30E-01
Chromium	18540-29-9	---	5.18E-02	---	---	---	---	1.50E-03	1.50E-03
Iron	7439-89-6	2.50E+04	7.87E+01	2.80E-01	---	---	2.80E-01	2.20E-02	3.00E-01
Manganese	7439-96-5	5.06E+02	5.04E+00	3.57E-02	1.82E-02	1.20E-02	6.59E-02	3.00E-03	6.89E-02
Thallium	7791-12-0	---	4.77E-03	---	---	---	---	5.10E-03	5.10E-03
Vanadium	7440-62-2	5.06E+01	6.17E-03	2.40E-02	2.80E-02	1.20E-03	5.32E-02	7.40E-05	5.30E-02
Zinc	7440-66-6	3.01E+03	9.67E+01	3.40E-02	5.10E-03	---	3.91E-02	1.60E-02	5.51E-02
			TOTAL	**5E-01**	**6E-02**	**1E-02**	**6E-01**	**6E-02**	**6E-01**

Table 25. Summary of Tier 1 Incremental Lifetime Risks and Hazards for the Trespasser Receptor
Eagle Zinc Company Site

COPC	CAS	Concentration			Soil Exposure through				Sediment	Surface Water Exposure through			Total Over All Media
		Soil (mg/kg)	Sediment (mg/kg)	Surface Water (mg/L)	Ingestion	Dermal Contact	Inhalation	Total	Ingestion	Ingestion	Dermal Contact	Total	
Tier 1 Incremental Lifetime Cancer Risk													
Arsenic	7440-38-2	7.93E+00	2.50E+01	---	3.08E-08	3.14E-09	1.58E-10	3.41E-08	9.71E-08	---	---	---	1.31E-07
Cadmium	7440-43-9	3.19E+01	5.50E+02	2.30E-01	---	---	2.66E-10	2.66E-10	---	---	---	---	2.66E-10
Iron	7439-89-6	2.50E+04	4.50E+04	1.50E+01	---	---	---	---	---	---	---	---	---
Manganese	7439-96-5	5.06E+02	---	---	---	---	---	---	---	---	---	---	---
Trichloroethylene (W)[a]	79-01-6	---	1.30E+01	6.30E-03	---	---	---	---	3.70E-10	1.79E-10	1.34E-09	1.52E-09	1.89E-09
Trichloroethylene (D)[b]									6.73E-10 to 1.30E-08	3.26E-10 to 6.50E-09	2.43E-09 to 4.90E-08	2.75E-09 to 5.50E-08	3.43E-09 to 6.90E-08
Vanadium	7440-62-2	5.06E+01	3.40E+01	---	---	---	---	---	---	---	---	---	---
Zinc	7440-66-6	1.10E+04	2.30E+04	2.60E+01	---	---	---	---	---	---	---	---	---
				TOTAL (W)	**3E-08**	**3E-09**	**4E-10**	**3E-08**	**1E-07**	**2E-10**	**1E-09**	**2E-09**	**1E-07**
				TOTAL (D)	**---**	**---**	**---**	**---**	**1E-07** to **1E-07**	**3E-10** to **7E-09**	**2E-09** to **5E-08**	**3E-09** to **6E-08**	**1E-07** to **2E-07**
Tier 1 Non-carcinogenic Hazard													
Arsenic	7440-38-2	7.93E+00	2.50E+01	---	8.00E-04	8.20E-05	---	8.82E-04	2.50E-03	---	---	---	3.38E-03
Cadmium	7440-43-9	3.19E+01	5.50E+02	2.30E-01	9.60E-04	1.30E-04	---	1.09E-03	1.70E-02	7.00E-03	2.00E-03	9.00E-03	2.71E-02
Iron	7439-89-6	2.50E+04	4.50E+04	1.50E+01	2.50E-03	---	---	2.50E-03	4.50E-03	1.50E-03	---	1.50E-03	8.50E-03
Manganese	7439-96-5	5.06E+02	---	---	1.10E-04	6.20E-05	5.50E-04	7.22E-04	---	---	---	---	7.22E-04
Trichloroethylene (W)[a]	79-01-6	---	1.30E+01	6.30E-03	---	---	---	---	6.50E-05	3.20E-05	2.40E-04	2.72E-04	3.37E-04
Trichloroethylene (D)[b]									1.30E-03	6.30E-04	4.70E-03	5.33E-03	6.60E-03
Vanadium	7440-62-2	5.06E+01	3.40E+01	---	2.20E-04	2.90E-04	5.50E-05	5.65E-04	1.50E-04	---	---	---	7.15E-04
Zinc	7440-66-6	1.10E+04	2.30E+04	2.60E+01	1.10E-03	1.90E-04	---	1.29E-03	2.30E-03	2.60E-03	4.60E-04	3.06E-03	6.65E-03
				TOTAL (W)	**6E-03**	**8E-04**	**6E-04**	**7E-03**	**3E-02**	**1E-02**	**3E-03**	**1E-02**	**5E-02**
				TOTAL (D)	**---**	**---**	**---**	**---**	**3E-02**	**1E-02**	**7E-03**	**2E-02**	**5E-02**

a - Calculations based on withdrawn toxicity criteria for trichloroethylene (W) (see Table 15)

b - Calculations based on proposed draft toxicity criteria for trichloroethylene (D) (see Table 15)

Table 26. Summary of Tier 1 Incremental Lifetime Risks and Hazards for the Off-Site Recreational Bather
Eagle Zinc Company Site

COPC	CAS	Concentration		Surface Water Exposure through			Sediment	Total Over All Media
		Surface Water (mg/L)	Sediment (mg/kg)	Ingestion	Dermal Contact	Total	Ingestion	
Tier 1 Incremental Lifetime Cancer Risk								
Arsenic	7440-38-2	---	3.20E+00	---	---	---	5.15E-08	5.15E-08
Cadmium	7440-43-9	5.30E-04	8.90E+00	---	---	---	---	---
Iron	7439-89-6	2.30E-01	8.50E+03	---	---	---	---	---
Trichloroethylene (W)[a]	79-01-6	3.90E-04	1.20E-03	1.50E-16	8.97E-10	8.97E-10	1.40E-13	8.97E-10
Trichloroethylene (D)[b]				2.72E-16 to 5.40E-15	1.63E-09 to 3.26E-08	1.63E-09 to 3.26E-08	2.58E-13 to 5.15E-12	1.60E-09 to 3.26E-08
Vanadium	7440-62-2	---	1.50E+01	---	---	---	---	---
Zinc	7440-66-6	8.40E-01	8.40E+03	---	---	---	---	---
			TOTAL (W)	**2E-16**	**9E-10**	**9E-10**	**5E-08**	**5E-08**
			TOTAL (D)	**3E-16 to 5E-15**	**2E-09 to 3E-08**	**2E-09 to 3E-08**	**5E-08 to 5E-08**	**5E-08 to 8E-08**
Tier 1 Non-carcinogenic Hazard								
Arsenic	7440-38-2	---	3.20E+00	---	---	---	2.70E-04	2.70E-04
Cadmium	7440-43-9	5.30E-04	8.90E+00	4.30E-05	1.00E-05	5.30E-05	2.20E-04	2.73E-04
Iron	7439-89-6	2.30E-01	8.50E+03	6.20E-05	---	6.20E-05	7.10E-04	7.72E-04
Trichloroethylene (W)[a]	79-01-6	3.90E-04	1.20E-03	5.30E-06	3.20E-05	3.70E-05	5.00E-09	3.70E-05
Trichloroethylene (D)[b]				1.10E-04	6.30E-04	7.40E-04	1.00E-07	7.40E-04
Vanadium	7440-62-2	---	1.50E+01	---	---	---	5.40E-05	5.40E-05
Zinc	7440-66-6	8.40E-01	8.40E+03	2.30E-04	3.20E-05	2.60E-04	7.00E-04	9.60E-04
			TOTAL (W)	**3E-04**	**7E-05**	**4E-04**	**2E-03**	**2E-03**
			TOTAL (D)	**4E-04**	**6E-04**	**1E-03**	**2E-03**	**3E-03**

a - Calculations based on withdrawn toxicity criteria for trichloroethylene (W) (see Table 15)
b - Calculations based on proposed draft toxicity criteria for trichloroethylene (D) (see Table 15)

Table 27. Summary of Tier 1 Incremental Lifetime Risks and Hazards for the Off-Site Resident Receptor
Eagle Zinc Company Site

COPC	CAS	Concentration in Surface Water (mg/L)	Surface Water (as a Potable Source) Exposure through		
			Ingestion	**Dermal Contact**	**Total**
Tier 1 Incremental Lifetime Cancer Risk					
Cadmium	7440-43-9	5.30E-04	---	---	---
Iron	7439-89-6	2.30E-01	---	---	---
Trichloroethylene (W)[a]	79-01-6	3.90E-04	6.40E-08	9.96E-09	7.40E-08
Trichloroethylene (D)[b]	79-01-6	3.90E-04	1.16E-07 to 2.30E-06	1.81E-08 to 3.62E-07	1.34E-07 to 2.66E-06
Zinc	7440-66-6	8.40E-01	---	---	---
		TOTAL (W)	**6E-08**	**1E-08**	**7E-08**
		TOTAL (D)	**1E-07 to 2E-06**	**2E-08 to 4E-07**	**1E-07 to 3E-06**
Tier 1 Non-carcinogenic Hazard					
Cadmium	7440-43-9	5.30E-04	1.80E-02	8.70E-05	1.80E-02
Iron	7439-89-6	2.30E-01	2.70E-02	---	2.70E-02
Trichloroethylene (W)[a]	79-01-6	3.90E-04	2.30E-03	3.50E-04	2.60E-03
Trichloroethylene (D)[b]	79-01-6	3.90E-04	4.50E-02	7.00E-03	5.20E-02
Zinc	7440-66-6	8.40E-01	9.70E-02	2.70E-04	9.70E-02
		TOTAL (W)	**1E-01**	**7E-04**	**1E-01**
		TOTAL (D)	**2E-01**	**7E-03**	**2E-01**

a - Calculations based on withdrawn toxicity criteria for trichloroethylene (W) (see Table 15)

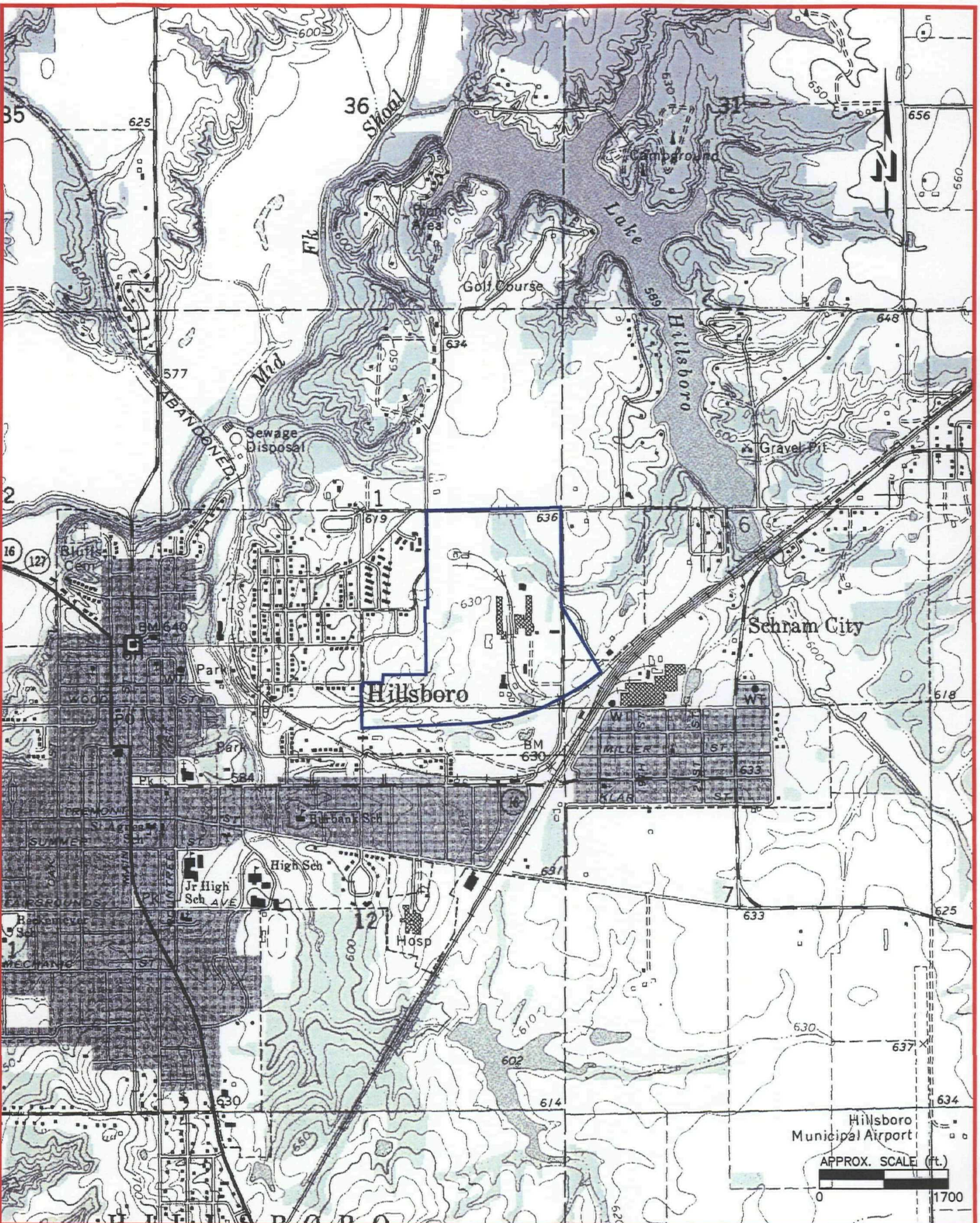
b - Calculations based on proposed draft toxicity criteria for trichloroethylene (D) (see Table 15)

Table 28. Summary of Tier 1 Incremental Lifetime Risks and Hazards for the Off-Site Recreational Fisher Receptor
Eagle Zinc Company Site

COPC	CAS	Concentration in Surface Water (mg/L)	Exposure through Fish Ingestion
Tier 1 Incremental Lifetime Cancer Risk			
Cadmium	7440-43-9	5.30E-04	---
Iron	7439-89-6	2.30E-01	---
Trichloroethylene (W)[a]	79-01-6	3.90E-04	1.00E-08
Trichloroethylene (D)[b]	79-01-6	3.90E-04	1.89E-08 to 3.80E-07
Zinc	7440-66-6	8.40E-01	---
		TOTAL (W)	**1E-08**
		TOTAL (D)	**2E-08 to 4E-07**
Tier 1 Non-carcinogenic Hazard			
Cadmium	7440-43-9	5.30E-04	8.80E-03
Iron	7439-89-6	2.30E-01	2.60E-04
Trichloroethylene (W)[a]	79-01-6	3.90E-04	3.70E-04
Trichloroethylene (D)[b]	79-01-6	3.90E-04	7.40E-03
Zinc	7440-66-6	8.40E-01	9.30E-01
		TOTAL (W)	**9E-01**
		TOTAL (D)	**9E-01**

a - Calculations based on withdrawn toxicity criteria for trichloroethylene (W) (see Table 15)
b - Calculations based on proposed draft toxicity criteria for trichloroethylene (D) (see Table 15)

FIGURES



R:\Client Project Files\Eagle Zinc-Hillsboro_21-7400E \Risk Assessment\HHRA_2004\Figures\Fig1 Site Location Map.dwg

ENVIRON

740 Waukegan Road, Suite 401, Deerfield, IL 60015

SITE LOCATION MAP
EAGLE ZINC
HILLSBORO, ILLINOIS

Figure

1

Drafter: APR | Date: 8/16/04 | Contract Number: 21-7400E | Approved: | Revised:

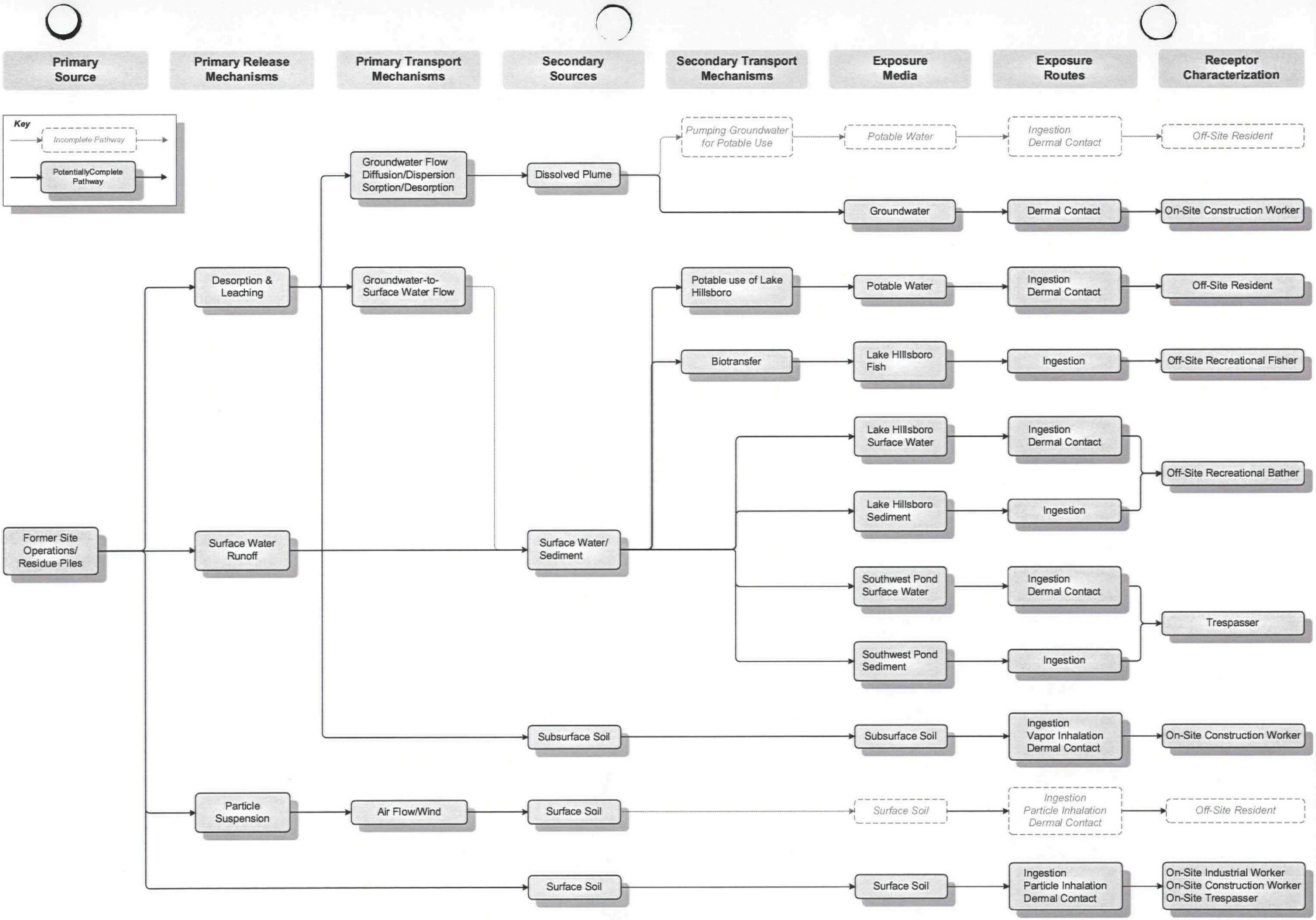


Figure 2
Exposure Pathway Conceptual Site Model
Eagle Zinc Company Site
Hillsboro, Illinois

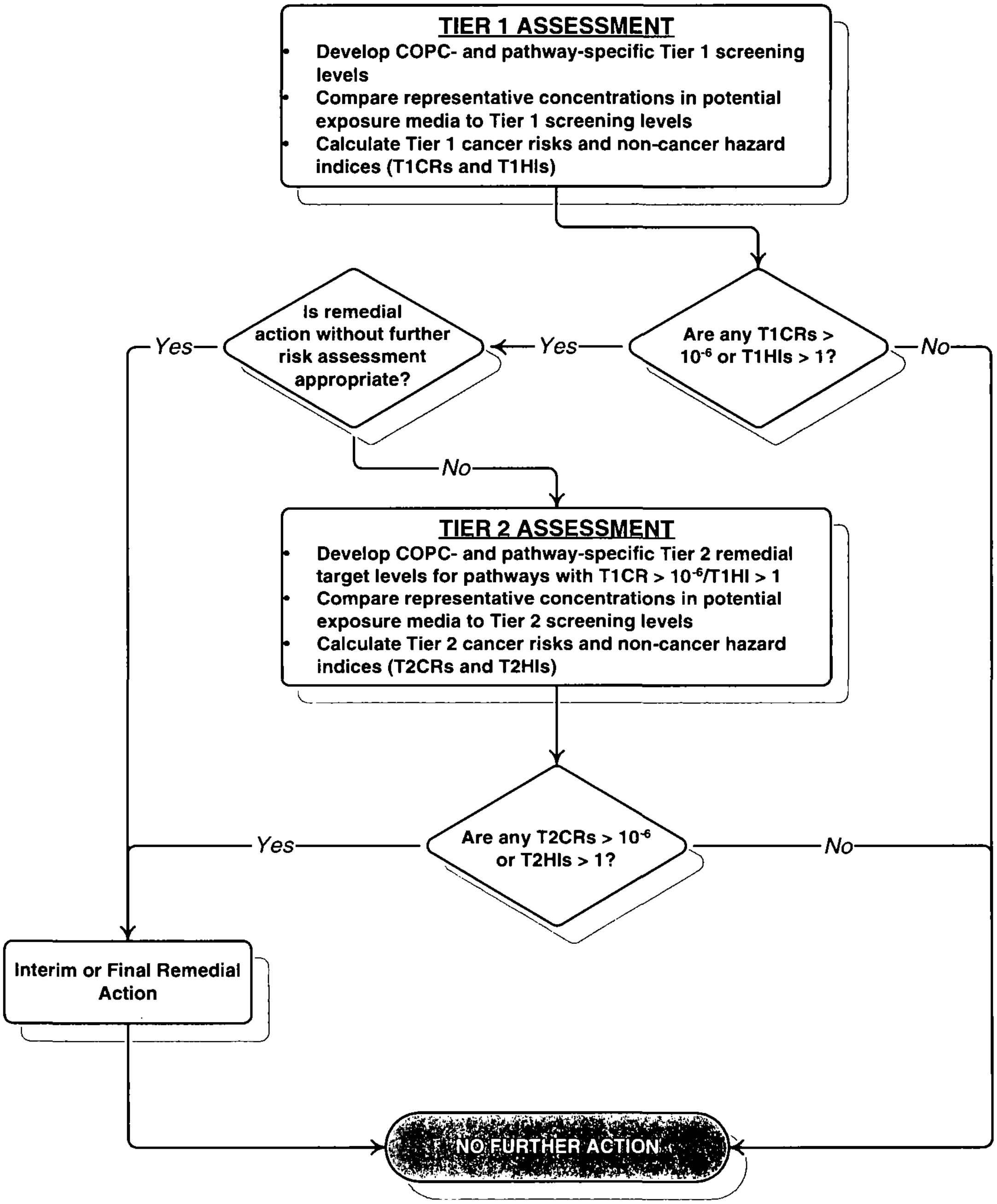
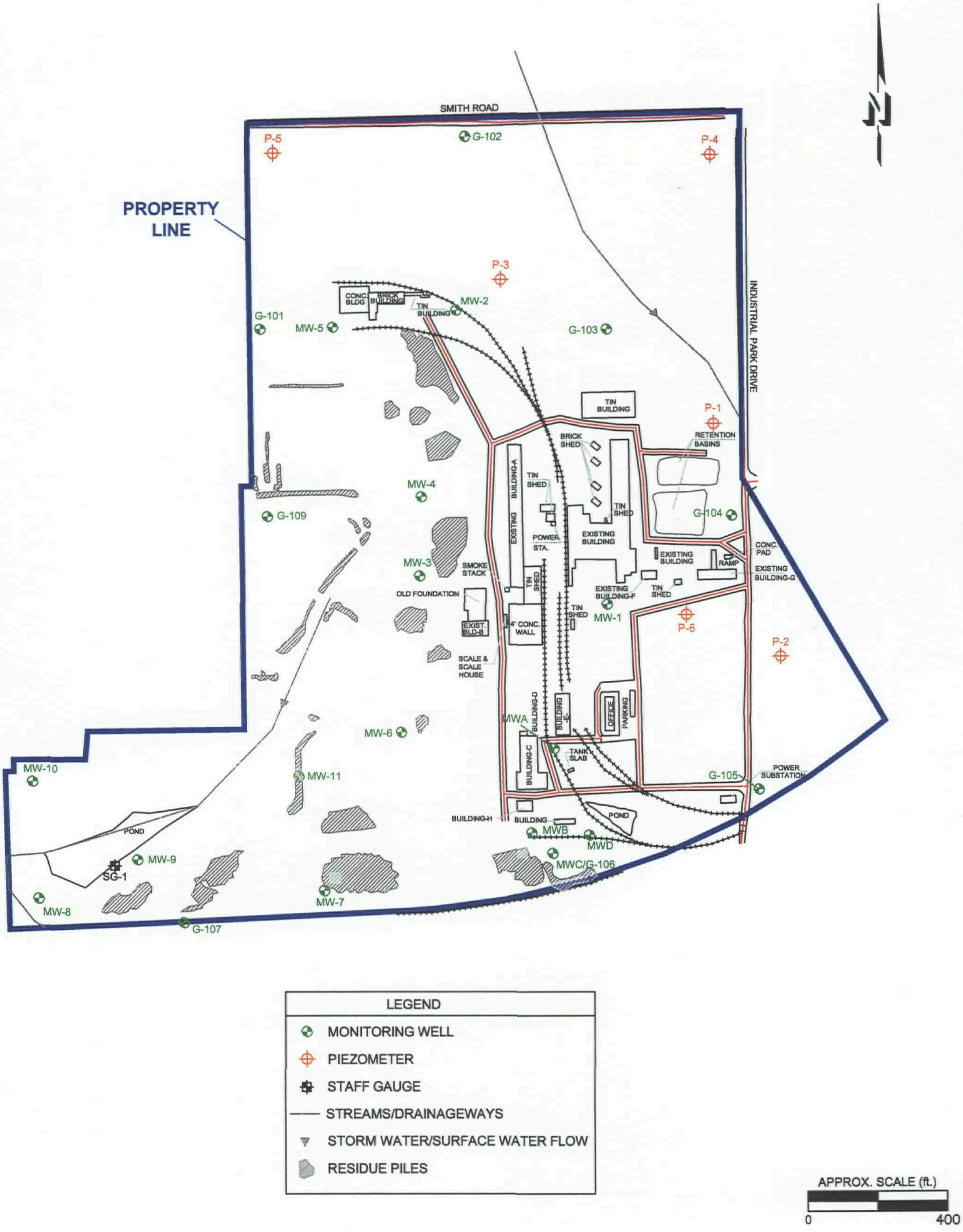


Figure 3

Conceptual Decision Tree

Eagle Zinc Company Site
Hillsboro, Illinois



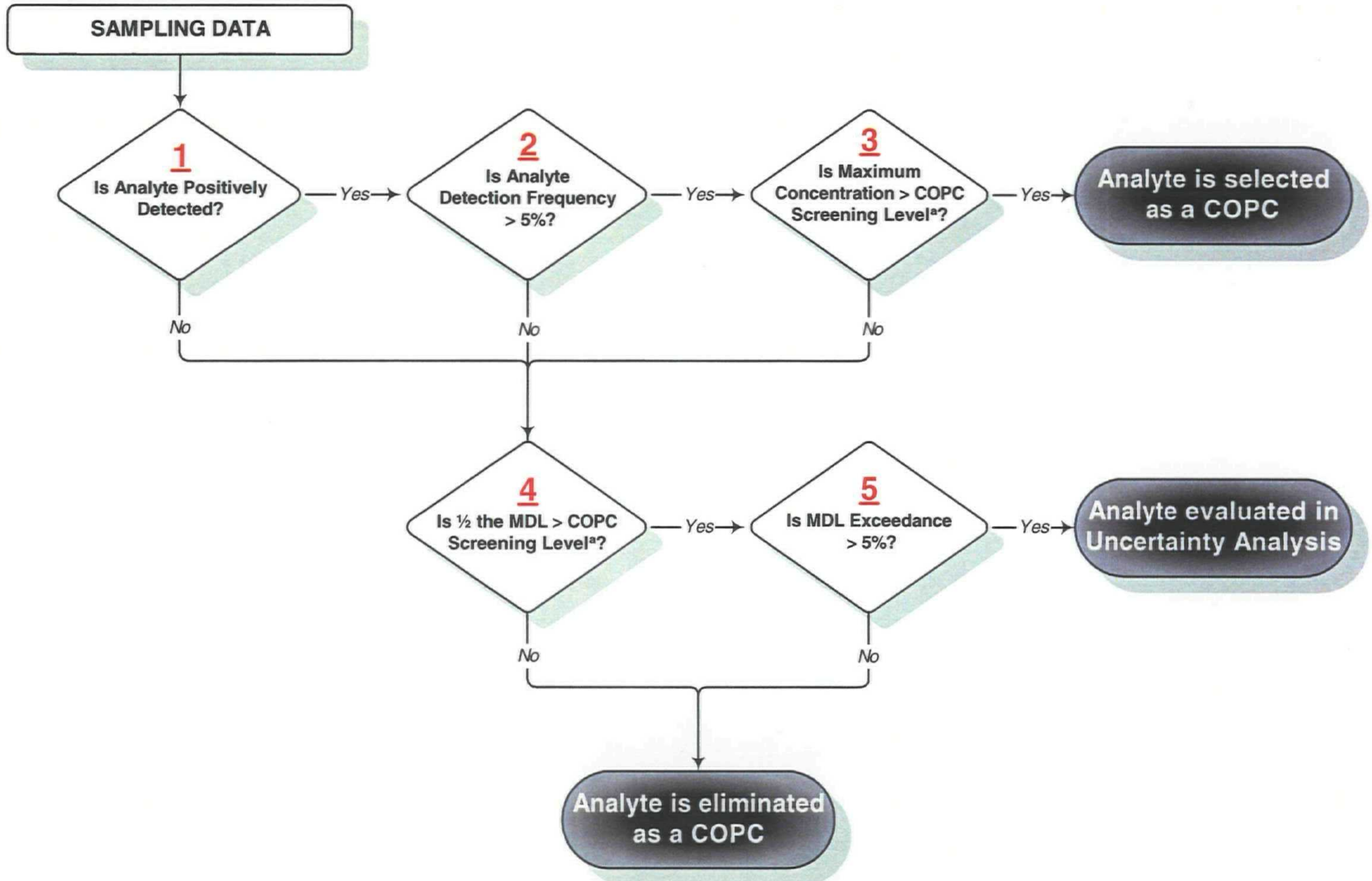
R:\Client Project Files\Eagle Zinc-Hillsboro_21-7400E\Risk Assessment\HHRA_2004\Figures\Fig4 Site Layout Map.dwg

ENVIRON
740 Waukegan Road, Suite 401, Deerfield, IL 60015

SITE LAYOUT MAP
EAGLE ZINC
HILLSBORO, ILLINOIS

Figure 4

Drafter: APR	Date: 8/16/04	Contract Number: 21-7400E	Approved:	Revised:



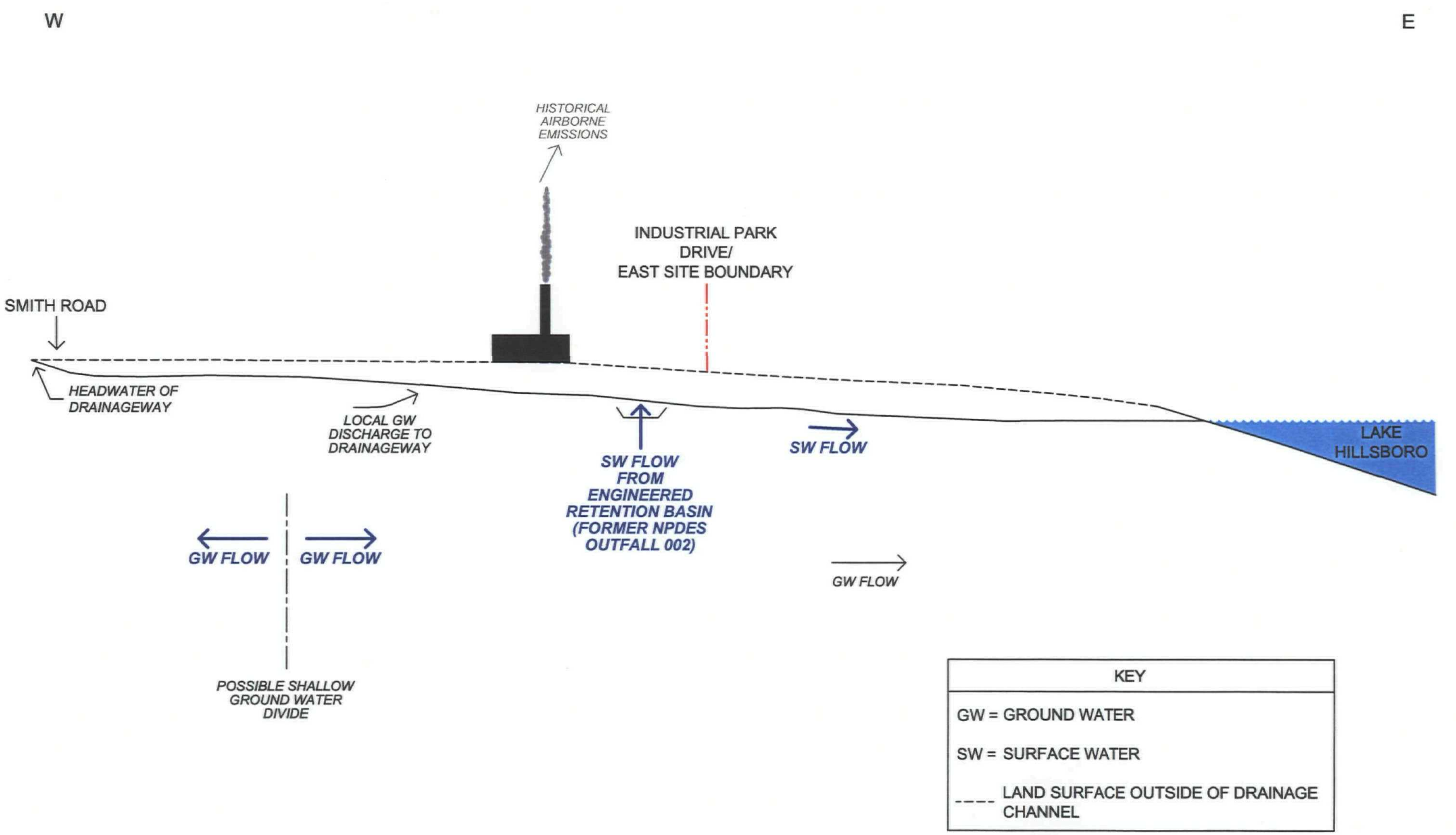
[a] - COPC Screening Level for soil/sediment is defined as the smaller of the Region 3 RBC for residential soil ingestion or the Illinois background concentration; for surface water and groundwater, the Region 3 RBC for tap water.

Figure 5

Decision Process for Selection of Chemicals of Potential Concern

Eagle Zinc Company Site

Hillsboro, Illinois



NOT TO SCALE

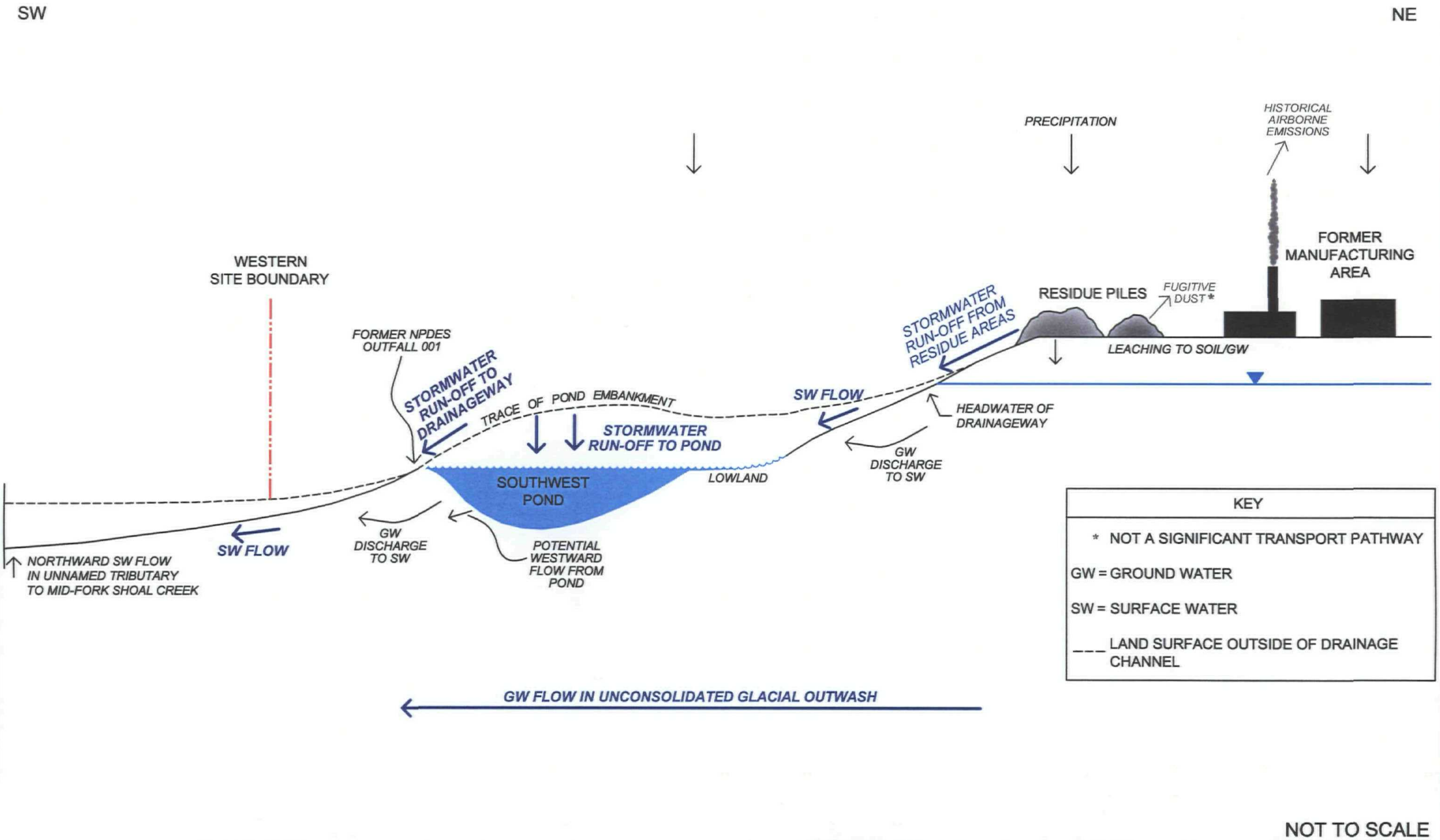
ENVIRON

FATE AND TRANSPORT CONCEPTUAL SITE MODEL: EASTERN DRAINAGEWAY
EAGLE ZINC
HILLSBORO, ILLINOIS

Figure 6

Drafter:	APR	Date:	8/16/04	Contract Number:	21-7400E	Approved:		Revised:	

R:\Client Project Files\Eagle Zinc-Hillsboro_21-7400E\Risk Assessment\HHRA_2004\Figures\Fig 6&7 F&T CSM-Drainageways.dwg



NOT TO SCALE

ENVIRON

FATE AND TRANSPORT CONCEPTUAL SITE MODEL: WESTERN DRAINAGEWAY
EAGLE ZINC
HILLSBORO, ILLINOIS

Figure
7

Drafter: APR | Date: 8/16/04 | Contract Number: 21-7400E | Approved: | Revised:

R:\Client Project Files\Eagle Zinc-Hillsboro_21-7400E \Risk Assessment\HHRA_2004\Figures\Fig 6&7 F&T CSM-Drainageways.dwg

ATTACHMENT A

Illinois Department of Public Health (IDPH 2002), Health Consultation
Eagle Zinc Company, Division of T.L. Diamond
Hillsboro, Montgomery County, Illinois

HEALTH CONSULTATION

EAGLE ZINC COMPANY
DIVISION OF T.L. DIAMOND
HILLSBORO, MONTGOMERY COUNTY, ILLINOIS

PURPOSE

The U.S. Environmental Protection Agency (USEPA) requested a health consultation for the Eagle Zinc Company site in Hillsboro, Illinois, to determine if a public health hazard exists due to actual or potential exposure to hazardous materials or conditions at the site. USEPA EXIT is considering the Eagle Zinc site for inclusion on the National Priorities List (NPL). A USEPA remedial investigation and feasibility study (RI/FS) began in summer 2002. This health consultation is based on the data currently available.

BACKGROUND AND STATEMENT OF ISSUES

Location

The city of Hillsboro is the county seat of Montgomery County with a population of 5,515, according to 2000 census data (Figure 1). The site is about 132 acres in size and is on the east side of Hillsboro, north of State Route 16. About 13 acres of the site are covered with buildings. Two ponds are located on the site - one in the southeast portion and one in the southwest portion.

The nearest home is part of a residential area about 200 feet southwest of the site. The nearest school is Burbank Grade School, which is about 0.25 miles southwest of the site. Homes to the east of the site are in an area known as Schram City. Northeast of the site are a glass company and trucking firm. North of the site is a small subdivision and a few small businesses. Also, Lake Hillsboro and an accompanying park have been developed north of the site, about 1 mile from the northern border of Eagle Zinc. A country club owns lakeside property with available activities including fishing, boating, camping, and swimming. Low-income multifamily public housing units, a few mobile homes, and privately-owned, single-family homes adjoin the western site property line.

History

Construction of the zinc facility began around 1910 and early operations reportedly began in 1914. Eagle Picher operated the plant until around 1980. In addition to zinc metal and zinc oxide, the former operators of the site produced lead pigment from lead ores; however, manufacture of lead products stopped following the federal ban on leaded residential paint in the late 1970s. Current specifications for the zinc oxide product do not allow more than 0.06% lead content. This is the same concentration determined by the U.S. Consumer Product Safety Commission for the maximum allowable lead concentration in new residential paints.

An Illinois Environmental Protection Agency (Illinois EPA) inspection in 1973 found that scrap metal, furnace residue, and metal-bearing material sorted by percentage of zinc were stored on the ground. At one time, much of the southwest corner of the property was covered with piles of a black residue. Reportedly, this material was used to surface roads at the facility. At times, efforts were made to ship this residue to other facilities to recover zinc, copper, and carbon, but these efforts were costly and limited in times of low market values.

Sherwin-Williams operated the facility from around 1980 to 1984. Since 1984, the Eagle Zinc Company, a division of T.L. Diamond & Company, Inc., has operated the facility. Since the early 1980s, the method of making zinc oxide uses zinc feedstock and anthracite coal. The fuel and feed stocks are delivered to the site by rail or by truck. Feed stocks vary in quality and might be crude or lower-quality zinc byproducts from other manufacturing facilities.

In 1981 and 1982, Illinois EPA sampled surface water and determined that elevated levels of zinc, cadmium, iron, lead, and copper were migrating off the site. This finding resulted in Sherwin-Williams Company having approximately 36 million pounds of furnace waste removed for reclamation. This material had covered about 10 acres of the site. Raw materials, products, and wastes have regularly been placed on the ground for on-site storage and disposal. No liners or dikes were constructed under or around these piles. Much of the material was at the southwest corner of the site. The spent materials have included rotary furnace residue, rotary furnace clean out, carbon plant hutch, muffle dross, building demolition debris, spent fire brick, silica-slags (zinc silicates, zinc ferrites, and iron silicates), and carbonaceous iron slag.

In 1993, Illinois EPA sampled soil, process wastes, and sediments. Some soil samples were collected from residential properties and school yards. Sediments were analyzed for organic and inorganic compounds, pesticides, and metals. Soil and solid wastes were analyzed for metals and inorganic compounds only. A background soil sample was collected from a residential property in Butler, Illinois. A background sediment sample was taken from a drainage way south of Hillsboro. Another smelting facility is about a mile south of Hillsboro and this facility might have contributed to metals detected in the background sediment sample.

Illinois EPA shared the analytical results for soil samples collected from homes near the site with IDPH. IDPH reviewed the data, evaluated any public health hazards, and mailed letters interpreting the results to the residents in February 1994. Manganese was identified as exceeding the public health guideline for children's soil exposure.

Also in 1993, sediment samples in surface drainage areas were collected on and off the site. Following an interim court order, plans were developed to collect samples during precipitation events to measure some contaminant migration.

On September 13, 1994, the USEPA Chief of Emergency Response concluded that the site did not require a time-critical or non-time-critical removal action; however, lead levels in materials on the site remained a concern.

If any private wells are being used in the area, it is likely that they are outside the city limits. The facility and households within the city limits are supplied with municipal water. As a result of a court order, the company installed groundwater monitoring wells in the late 1990s and sample collection began in late 1998.

The Illinois EPA Division of Water Pollution Control collected storm water samples in January 1998. Samples were collected from a discharge channel of the southwest pond and from the intermittent stream that drains the northeast portion of the site. An upstream sample was also collected. Surface water and storm water samples have been collected regularly during precipitation events since 1998 at two sampling locations at the edge of the plant property to determine the extent of the migration of metals in storm water.

On-site residues were sampled in May 1998 and analyzed for lead and cadmium to help characterize the different waste piles. One pile had a maximum lead concentration of 50,290 parts per million (ppm). The highest cadmium concentration was 66.7 ppm. Three of seven sediment samples contained low levels of PCBs, but the maximum level detected was 0.36 ppm.

Current Status

Current production generates approximately 5 tons of rotary furnace residue per day, with 400 tons of furnace residue removed from the equipment each year. Besides application as a fungicide, the zinc oxide produced is used in pigments, ceramic glazes, adhesives, and rubber-making (vulcanization process). In the past, many buildings were on the site, with as much as 26 acres covered with buildings and associated structures. Currently, the main buildings include an office building-laboratory, a storage building, and a furnace-bag house where zinc oxide is produced. The plant also adds zinc coatings to shingles to retard fungal growth. The scale of current operations is small relative to past production.

Wastes generated at the facility laboratory are discharged into the public sanitary sewer system, and a small amount of equipment waste oil is collected by a recycling business. These wastes are small compared with the large piles of metal-based residues that have been regularly generated as byproducts of the main processes. Eagle Zinc maintains an air pollution control permit for two rotary furnaces with baghouses, one waezling furnace, one rotary dryer, one muffle furnace door hood and two propane storage tanks.

Ponds, wetlands, and surface water exist on the site property. Two ponds collect surface runoff on the southern end of the property. The slight sloping area topography drains to the west. From there, surface water moves toward the south until captured by the pond in the southwest corner. This pond was formed by damming the drainage with solid residue from the facility. Before the construction of a public swimming pool in Hillsboro, residents reportedly were allowed to swim in the southwestern pond. Inspectors have reported breaches in the dam and that runoff is deposited into unnamed tributaries of Middle Fork Shoal Creek. Runoff also occurs at the northeast portion of the site to an unnamed tributary of Lake Hillsboro, about 0.5 miles from the site. Illinois EPA staff has determined that the site does not appear to affect the area municipal water supply, which originates from lakes north of the site.

In 1998, an interim court order was signed, and environmental sampling data are now being generated on a regular basis. In December 2001, USEPA signed a consent order with T.L. Diamond, Sherwin-Williams, and Eagle-Picher to investigate and assess the extent of contamination at the site. A remedial investigation and feasibility study (RI/FS) began in the summer of 2002 and should be completed in 2004. USEPA has invited IDPH staff to participate in future site visits and assessment activities.

Site Visit

IDPH staff visited the site most recently on May 9, 2002. A public road cuts through the facility. Vegetation on the site appeared to be distressed. Children's outdoor play equipment was observed on the properties along 17th Street in Schram City. The site is easily accessed since fencing does not completely enclose the area.

DISCUSSION

Chemicals of Interest

IDPH compared the results of the available environmental samples with appropriate comparison values to select chemicals for further evaluation for exposure and possible carcinogenic and noncarcinogenic health effects. Chemicals found at levels greater than comparison values, or those for which no comparison values exist, were selected for further evaluation. A discussion of each comparison value used is found in Attachment 2. IDPH assumed that the samples were collected and handled properly and that appropriate analytical techniques were used.

The chemicals of interest in surface water, sediment, and on-site soil are arsenic, barium, cadmium, cobalt, copper, lead, manganese, and zinc. The only chemical of interest detected in residential soil was manganese.

Exposure Assessment

An exposure pathway consists of a source of contamination, environmental media and transport mechanisms, a point of exposure, and a receptor population. Exposure to a chemical may have occurred in the past, may be occurring now, or may occur in the future. When all these elements linking the chemical source to an exposed population are known, a completed exposure pathway exists. When one of these elements is missing, a potential exposure pathway exists.

The persons who may have been exposed to site-related chemicals in the past, present, or future are site workers and nearby residents. Exposures to inorganic chemicals can occur by ingestion and inhalation of contaminated soil and inhalation of dust from the site.

Residential Soil

Chemicals in residential soil are a completed exposure pathway. IDPH assumed that children could be exposed to the highest levels of chemicals found in residential soil while playing and would ingest 200 milligrams of soil daily, 10 months per year.

On the basis of this exposure scenario, no adverse health effects would be expected from exposure to chemicals in residential soil.

On-site Soil, Sediment, and Waste

Exposure to chemicals in on-site soil, sediment, and wastes are a completed exposure pathway for workers and trespassers. IDPH assumed adult workers who did not use personal protective equipment while contacting the soil and waste would ingest dirt and dust when working 5 days per week, 50 weeks per year. For trespassers, IDPH estimated an older child coming onto the site would contact soil and waste 2 days per week for 20 weeks per year.

On the basis of these exposure scenarios, no adverse health effects would be expected for adult workers or trespassers contacting on-site soil, sediment, and waste.

Workers

Workers may inhale metals while the facility is operating. Breathing too many metal particles or dust contaminated with metals can cause irritation of the lungs. This can be especially problematic for those with respiratory disorders or allergies. In addition, it can increase the chances of lung infection or make breathing difficult. This phenomenon can occur for many metals as well as mixtures of particles. Some refer to this condition as "metal fume fever." Metal fume fever has occurred as a result of high-dose exposures in other occupational settings, but we do not know if it has occurred at Eagle Zinc. Little is known about the long-term effects of breathing metallic dusts. No airborne particulate data exists for this site.

Surface Water

Past exposures to contaminated water and sediment were likely to have occurred when residents would swim in surface water on the site. This practice no longer occurs. Sampling of sediments and storm water has shown that they contain elevated levels of metals, but IDPH cannot reconstruct the past exposures.

Groundwater

The closest well identified from records reviewed in 1993 was about 0.5 miles east of the site, outside the city limits. The facility and households within the city limits are supplied with public water. Illinois EPA staff reviewed private well records maintained by the Illinois State Geological Survey and found that the existing private wells were approximately 50 feet deep, below a layer of clay that exists at a depth of 12 to 18 feet. Therefore, site-related chemicals are unlikely to affect off-site groundwater because metals are not mobile in soil or very soluble in water, there is a confining clay layer, and the closest private well is some distance from the site.

COMMUNITY HEALTH CONCERNS

On May 9, 2002, about 60 people attended a public meeting hosted by USEPA. Updated information on the site was provided. The overall work plan was discussed and the clean-up process was explained. The main community concerns were about procedural and communication issues, and about current operations.

CHILD HEALTH INITIATIVE

IDPH recognizes that children are especially sensitive to some contaminants. For this reason, IDPH included children when evaluating exposures to site-related chemicals. While manganese was found at elevated levels in residential soil, no adverse health effects would be expected for children while playing and ingesting 200 milligrams of soil daily, 10 months per year.

CONCLUSIONS

On the basis of the available data and information reviewed, the Illinois Department of Public Health concludes that under current conditions this site poses no apparent public health hazard to the residents of Hillsboro. Processing and smelting primary ores for zinc and lead, and fueling furnaces with coal, have resulted in accumulation of metals in on-site soil, waste, and sediments. These are not, however, at levels that would cause adverse health effects on the basis of the available data and our trespasser exposure scenario.

RECOMMENDATIONS AND PUBLIC HEALTH ACTION PLAN

Although current data do not show that a public health hazard exists, limiting current exposures would be prudent and prevent future exposures to materials stored at the site. Careful handling of site wastes should prevent undue exposures for workers and nearby residents. IDPH recommends that USEPA prevent public access to the site during any remediation activity. Additional environmental sampling results will be generated as USEPA begins an RI/FS this year. IDPH will review and assess the health significance of these data.

PREPARER OF REPORT

Catherine Copley
Environmental Health Specialist
Illinois Department of Public Health

REFERENCES

1. Illinois Environmental Protection Agency, Division of Land Pollution Control. Freedom of Information file inspections on September 19, 1994, and December 10, 2001. Springfield, Illinois: Illinois Environmental Protection Agency.

2. Illinois Environmental Protection Agency, Office of Chemical Safety. A summary of selected background conditions for inorganics in soil. Springfield, Illinois: Illinois Environmental Protection Agency; 1994 Aug.

3. Agency for Toxic Substances and Disease Registry. Toxicological profiles for arsenic, cadmium, cobalt, copper, lead, manganese, nickel, silver, thallium, and zinc. Atlanta: US Department of Health and Human Services.

CERTIFICATION

This Eagle Zinc Company health consultation was prepared by the Illinois Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

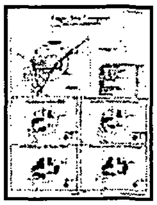
W. Allen Robison
Technical Project Officer
Superfund Site Assessment Branch (SAAB)
Division of Health Assessment and Consultation (DAC)
ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation and concurs with its findings.

Lisa C. Hayes

for Roberta Erlwein
Chief, State Programs Section
SSAB, DHAC, ATSDR

ATTACHMENT 1: SITE MAP



ATTACHMENT 2: COMPARISON VALUES USED IN SCREENING CONTAMINANTS FOR FURTHER EVALUATION

Environmental media evaluation guides (EMEGs) are developed for chemicals on the basis of their toxicity, frequency of occurrence at National Priorities List (NPL) sites, and potential for human exposure. They are not action levels but are comparison values. They are developed without consideration for carcinogenic effects, chemical interactions, multiple route exposure, or exposure through other environmental media. They are very conservative concentration values designed to protect sensitive members of the population.

Reference dose media evaluation guides (RMEGs) are another type of comparison value. They are developed without consideration for carcinogenic effects, chemical interactions, multiple route exposure, or exposure through other environmental media. RMEGs are very conservative concentration values designed to protect sensitive members of the population.

Cancer risk evaluation guides (CREGs) are estimated contaminant concentrations that are based on a probability of 1 excess cancer in 1 million persons exposed to a chemical over a lifetime.

Maximum contaminant levels (MCLs) have been established by USEPA for public water supplies to reduce the chances of occurrence of adverse health effects from use of contaminated drinking water. These standards are well below levels for which health effects have been observed and take into account the financial feasibility of achieving specific contaminant levels. These are enforceable limits that public water supplies must meet.

Lifetime health advisories for drinking water (LTHAs) have been established by USEPA for drinking water. The advisories represent the concentrations of chemicals in drinking water that are not expected to cause any adverse, noncarcinogenic effects over a lifetime of exposure. LTHAs are conservative values that incorporate a margin of safety.

Table of Contents

ATTACHMENT B

December 19, 2003
Statement from Hillsboro Planning Commission

HILLSBORO PLANNING COMMISSION

December 19, 2003

Dear John M. Ix, Esq.,

The Hillsboro Planning Commission in its newly developed long term plan is recommending that the City of Hillsboro acquire the Eagle Zinc property for use as an industrial park subject to a mutually acceptable agreement with the current owner especially with respect to environmental aspects of the property. The acquisition will provide an additional tax base for the City as well as valuable railroad siding, building and real property.

Sincerely,

Thomas L. Gooding
Planning Commission President

cc: Mayor Baran
Dion Novak

ATTACHMENT C

Estimation of 95% Upper Confidence Limits

ESTIMATION OF 95% UPPER CONFIDENCE LIMITS

Representative concentrations for the compounds identified as COPCs were estimated using an in-house program developed by ENVIRON for the purpose of easily estimating 95% UCL for sampling data. This program takes as input a Microsoft Access database formatted into specific columns containing all the relevant site information necessary for the estimation of the 95% UCL. Sampling data used in the estimation of 95% UCLs for on-site soil and groundwater are presented in Tables C-1 and C-3, respectively. Each of the fields is briefly described below:

- ID – identifies the record being evaluated.
- Area – Specifies the area of the site being evaluated. This field is used to subset the data such estimates can be calculated for multiple areas during a single run.
- Media – Specifies the media under evaluation. As with the area, multiple media could be evaluated during the same run.
- Depth – Different depths within the same media and area could be subsetted.
- Date – Date sampled was obtained.
- Sample – Sample identifier.
- S/D – Indicates if the sample is a split or a duplicate.
- Compound – Compound being evaluated.
- Value – Detected concentration or detection limit if not detected.
- Units – Units in which the Value is specified.
- QA/QC – Qualifiers.
- F/UF – For water media indicates if the sample was filtered or unfiltered.
- Reporting Limit – Detection limit of the compound.

The input file is saved as a text delimited file which is then imported into SAS® routines developed in-house which estimate the distribution of the data and determines a variety of UCLs. Of specific interest are:

- Normal 95% Upper Confidence Limit on the Mean (N95 UCL)
- Lognormal 95% Upper Confidence Limit on the Mean (LN95 UCL)
- Non-parametric 95% Upper Confidence Limit on the Mean (NP95 UCL)

The distribution is estimated within SAS® using the Shapiro-Wilk test since the number of sample points was less than 100. If more than 100 individual samples points were available then the Kolomogorov-Smirnov test would be used. Certain summary statistics, such as the minimum and maximum detected concentrations and detection limits and the mean concentration, and the N95 UCL are also estimated within SAS®. As discussed below, the LN95 and NP95 are estimated by a separate program using techniques presented in Atichison and Brown (1976) and Singh *et al.* (1997). These techniques are briefly described below.

The methods used in this program the estimate the 95% UCL can be viewed as variations of a basic approach to constructing confidence intervals known as the pivotal quantity method. In general, a pivotal quantity is a function of both the parameter (θ) and an estimate ($\hat{\theta}$) such that probability distribution of the pivotal quantity does not depend on θ. The best known example of a pivotal quantity is the well-known t statistic,

$$t = \frac{\bar{x} - \mu_1}{s_x / \sqrt{n}}$$

where $\bar{x}$ and s_x are, respectively, the sample mean and sample standard deviation. If the data is a random sample from a normal population with mean, μ_1, and standard deviation, σ_1, then the distribution of this pivotal quantity is the familiar Student's t distribution with n-1 degrees of freedom. Because the Student's t distribution does not depend on either unknown parameter, quantiles are available. Denote by $t_{\alpha,n-1}$ the upper .αth quantile of the Student's t distribution with n-1 degrees of freedom. Based on equation above, it is possible to derive a (1-2α.)100% confidence interval of the form

$$(\bar{x} - t_{\alpha,n-1} \times s_x / \sqrt{n}, \bar{x} + t_{\alpha,n-1} \times s_x / \sqrt{n})$$

The confidence interval is given in the familiar form of a two-sided confidence interval for the mean. If the lower limit of this interval is disregarded, the upper limit provides a (1-α)100% UCL for the mean, μ1.

If the population is normally distributed, the t-statistic method of obtaining an UCL is the best method (variable N95 UCL). However, if the population appears to be log-normally distributed or is not adequately described by either a normal or lognormal distribution, then non-parametric methods are better suited for obtaining an UCL. Bootstrap and Jackknife procedures are non-parametric statistical methods with require no assumptions regarding the statistical distribution of the underlying population. Both methods are based on resampling techniques.

In the jackknife approach, calculation of the jackknife estimator for the UCL follows the following procedure:

1. Calculate a sample mean from all n samples:

$$\hat{\theta} = \frac{\sum_{j=1}^{n} x_j}{n}$$

2. Calculate n additional estimates of θ by deleting one observation each time. Specifically for each sample value xi, compute a mean θ_i as in step one but omitting xi from the calculation.
3. Calculate $\tilde{\theta} = \frac{1}{n}\sum_{i=1}^{n}\hat{\theta}_i$
4. Calculate the n jackknife values as $J_i = n\hat{\theta} - (n-1)\hat{\theta}_i$
5. The jackknife estimator of θ is given by $J(\hat{\theta}) = \frac{1}{n}\sum_{i=1}^{n} J_i$
6. The estimate of the standard error of the jackknife estimate $J(\hat{\theta})$ is given by

$$\hat{\sigma}_{J(\hat{\theta})} = \sqrt{\frac{1}{n(n-1)}\sum_{i=1}^{n}(J_i - J(\hat{\theta}))^2}$$

7. These values can then be used to obtain confidence intervals for the parameter using the following pivotal quantity

$$t = \frac{J(\hat{\theta}) - \theta}{\hat{\sigma}_{J(\hat{\theta})}}$$

which has an approximate Student's t distribution with n-1 degrees of freedom and can be used to drive the following approximately two-sided (1-2α) 100 % UCL for θ.

$$(J(\hat{\theta}) - t_{\alpha,n-1} \times \hat{\sigma}_{J(\hat{\theta})}, J(\hat{\theta}) + t_{\alpha,n-1} \times \hat{\sigma}_{J(\hat{\theta})})$$

This method is used both for the non-parametric UCL (NP95 UCL) and the lognormal UCL (LN95 UCL). In the case of the lognormal, the computation of the mean uses the MVUE method instead of the simple arithmetic mean specified in step one above. The MVUE means is given by the following procedure:

1. With $y_i = \ln(x_i)$ compute $\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$ and $s_y^2 = \frac{1}{n-1}\sum_{i=1}^{n}(y_i - \bar{y})^2$
2. Calculate the MVUE mean as $\hat{\mu}_1 = \exp(\bar{y})\psi_n(s_y^2/2)$ where ψ_n is a function with an infinite series solution given by Atichison and Brown (1976).

A bootstrap approach is a Monte Carlo style approach with repeated samples of size n drawn with replacement for the given set of observations. This process is repeated a large number of times (N) and each time an estimate for the sample mean ($\bar{x}_i$) is calculated using the formula for a simple arithmetic mean. The bootstrap estimate of the mean $\bar{x}_B$ is a simple arithmetic average of all the means calculated during the bootstrap process. The estimate of the standard error is

$$s_B = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(\bar{x}_i - \bar{x}_B)^2}$$

The standard bootstrap confidence interval is derived from the following pivotal quantity:

$$z = \frac{\bar{x}_B - \mu}{s_b}$$

and the (1-2α) 100% standard bootstrap confidence interval for $\bar{x}_B$ is

$$(\bar{x}_B - z_\alpha s_B, \bar{x}_B + z_\alpha s_B).$$

The bootstrap procedure described above is how the variable NP95 Boot UCL are calculated.

Summary tables are presented for both soil (Table __-2) and groundwater (Table __-3) detailing the minimum and maximum detected concentration and reporting limits, the number of samples obtained, the number of samples with a detected concentration (e.g., number of hits), the mean concentration, the distribution type, and the 95% UCLs. For this analysis, the UCL corresponding to the identified distribution type was used as the representative concentration if less than the maximum detected concentration. If the UCL was greater than the maximum concentration then the maximum concentration was used as the representative concentration.

References

Atichison, J. and Brown, J.A.C. 1976/The Lognormal Distribution, Cambridge: Cambridge University Press.

Singh, Ashok K., Singh, Anita, and Engelhardt, Max. 1997. The Lognormal Distirbution in Environmental Applications. United States Environmental Protection Agency, Office of Research and Development, Office of Solid Waste and Emergency Response.

Table C-1. Soil Analytical Data (mg/kg) Used in the Estimation of On-Site 95% Upper Confidence Limits

ID	Date	Sample	Analyte	Value	QA/QC	Reporting Limit
1	07/19/2002	A3-20-2	Arsenic	8.3		1.7
2	07/19/2002	A3-23-2	Arsenic	4.8		0.35
3	07/18/2002	A3-25-2	Arsenic	8.2		0.7
4	07/18/2002	A2-7-3	Arsenic	12		0.41
5	07/18/2002	A2-15-3	Arsenic	3.9		0.38
6	07/18/2002	A2-23-3	Arsenic	4.2		0.39
7	07/18/2002	A2-24-3	Arsenic	4.1		0.37
8	07/18/2002	A2-19-6	Arsenic	12		0.43
9	07/16/2002	S-A1-23-7	Arsenic	6.1		0.37
10	07/16/2002	S-A1-24-10	Arsenic	5.1		0.73
11	07/15/2002	S-A1-3-9	Arsenic	3.7		0.33
12	07/15/2002	S-A1-6-9	Arsenic	1.9		0.34
13	07/15/2002	S-A1-7-3	Arsenic	4.3		0.72
14	07/19/2002	S-A3-19-5	Arsenic	13		0.79
15	07/19/2002	S-A3-22-6	Arsenic	6.8		0.34
16	07/19/2002	S-A4-15-2	Arsenic	11		2.1
17	07/19/2002	S-A4-15-20	Arsenic	13		2.2
18	07/19/2002	S-A4-1-6	Arsenic	3.4		0.75
19	07/19/2002	S-A4-17-2	Arsenic	9.3		1.8
20	07/19/2002	S-A4-22-2	Arsenic	8.4		0.78
21	07/19/2002	S-A4-3-2	Arsenic	3.3		1.7
22	07/17/2002	S-MA-6-4	Arsenic	11		0.34
23	07/17/2002	S-MA-9-2	Arsenic	7.2		1.9
24	07/17/2002	S-NA-8-2	Arsenic	4		0.41
25	07/17/2002	S-NA9-2	Arsenic	6.3		0.35
26	07/17/2002	S-NA9-2D	Arsenic	5		0.77
27	07/17/2002	S-WA-8-2	Arsenic	6.4		0.38
28	07/17/2002	S-WA-9-2	Arsenic	2.3		0.37
29	07/19/2002	A3-20-2	Cadmium	6.3		0.2
30	07/19/2002	A3-23-2	Cadmium	7.9		0.041
31	07/18/2002	A3-25-2	Cadmium	33		0.081
32	07/18/2002	A2-7-3	Cadmium	1.6		0.047
33	07/18/2002	A2-15-3	Cadmium	6.8		0.044
34	07/18/2002	A2-23-3	Cadmium	4.2		0.045
35	07/18/2002	A2-24-3	Cadmium	13		0.043
36	07/18/2002	A2-19-6	Cadmium	3.8		0.049
37	07/16/2002	S-A1-23-7	Cadmium	56		0.043
38	07/16/2002	S-A1-24-10	Cadmium	6.1		0.084
39	07/15/2002	S-A1-3-9	Cadmium	5.6		0.039
40	07/15/2002	S-A1-6-9	Cadmium	87		0.04
41	07/15/2002	S-A1-7-3	Cadmium	44		0.083
42	07/19/2002	S-A3-19-5	Cadmium	19		0.091
43	07/19/2002	S-A3-22-6	Cadmium	21		0.039
44	07/19/2002	S-A4-15-2	Cadmium	1		0.24
45	07/19/2002	S-A4-15-20	Cadmium	0.51	J	0.25
46	07/19/2002	S-A4-1-6	Cadmium	0.41		0.086
47	07/19/2002	S-A4-17-2	Cadmium	1.2		0.21
48	07/19/2002	S-A4-22-2	Cadmium	1.3		0.09

Table C-1. Soil Analytical Data (mg/kg) Used in the Estimation of On-Site 95% Upper Confidence Limits

ID	Date	Sample	Analyte	Value	QA/QC	Reporting Limit
49	07/19/2002	S-A4-3-2	Cadmium	1.5	J	0.2
50	07/17/2002	S-MA-6-4	Cadmium	2		0.039
51	07/17/2002	S-MA-9-2	Cadmium	8.2		0.22
52	07/17/2002	S-NA-8-2	Cadmium	0.12		0.047
53	07/17/2002	S-NA9-2	Cadmium	0.83		0.04
54	07/17/2002	S-NA9-2D	Cadmium	0.55		0.089
55	07/17/2002	S-WA-8-2	Cadmium	25		0.044
56	07/17/2002	S-WA-9-2	Cadmium	70		0.043
57	07/19/2002	A3-20-2	Iron	29000		17
58	07/19/2002	A3-23-2	Iron	22000		34
59	07/18/2002	A3-25-2	Iron	25000		6.8
60	07/18/2002	A2-7-3	Iron	31000		3.9
61	07/18/2002	A2-15-3	Iron	21000		3.7
62	07/18/2002	A2-23-3	Iron	19000		3.8
63	07/18/2002	A2-24-3	Iron	16000		3.6
64	07/18/2002	A2-19-6	Iron	26000		4.1
65	07/16/2002	S-A1-23-7	Iron	18000		3.6
66	07/16/2002	S-A1-24-10	Iron	16000		7.1
67	07/15/2002	S-A1-3-9	Iron	15000		3.2
68	07/15/2002	S-A1-6-9	Iron	10000		3.3
69	07/15/2002	S-A1-7-3	Iron	14000		7
70	07/19/2002	S-A3-19-5	Iron	31000		7.7
71	07/19/2002	S-A3-22-6	Iron	18000		3.3
72	07/19/2002	S-A4-15-2	Iron	29000		20
73	07/19/2002	S-A4-15-20	Iron	35000		21
74	07/19/2002	S-A4-1-6	Iron	12000		7.2
75	07/19/2002	S-A4-17-2	Iron	24000		18
76	07/19/2002	S-A4-22-2	Iron	19000		38
77	07/19/2002	S-A4-3-2	Iron	16000		17
78	07/17/2002	S-MA-6-4	Iron	29000		3.3
79	07/17/2002	S-MA-9-2	Iron	27000		18
80	07/17/2002	S-NA-8-2	Iron	15000		3.9
81	07/17/2002	S-NA9-2	Iron	26000		3.4
82	07/17/2002	S-NA9-2D	Iron	23000		7.4
83	07/17/2002	S-WA-8-2	Iron	47000		3.7
84	07/17/2002	S-WA-9-2	Iron	9100		3.6
85	07/19/2002	A3-20-2	Manganese	350		0.28
86	07/19/2002	A3-23-2	Manganese	68		0.057
87	07/18/2002	A3-25-2	Manganese	410		0.11
88	07/18/2002	A2-7-3	Manganese	610		0.066
89	07/18/2002	A2-15-3	Manganese	82		0.062
90	07/18/2002	A2-23-3	Manganese	87		0.063
91	07/18/2002	A2-24-3	Manganese	140		0.06
92	07/18/2002	A2-19-6	Manganese	540		0.069
93	07/16/2002	S-A1-23-7	Manganese	200		0.06
94	07/16/2002	S-A1-24-10	Manganese	180		0.12
95	07/15/2002	S-A1-3-9	Manganese	98		0.054
96	07/15/2002	S-A1-6-9	Manganese	400		0.056

Table C-1. Soil Analytical Data (mg/kg) Used in the Estimation of On-Site 95% Upper Confidence Limits

ID	Date	Sample	Analyte	Value	QA/QC	Reporting Limit
97	07/15/2002	S-A1-7-3	Manganese	120		0.12
98	07/19/2002	S-A3-19-5	Manganese	280	J	0.13
99	07/19/2002	S-A3-22-6	Manganese	230	J	0.055
100	07/19/2002	S-A4-15-2	Manganese	1900	J	0.33
101	07/19/2002	S-A4-15-20	Manganese	360	J	0.36
102	07/19/2002	S-A4-1-6	Manganese	1200	J	0.12
103	07/19/2002	S-A4-17-2	Manganese	920	J	0.3
104	07/19/2002	S-A4-22-2	Manganese	420	J	0.13
105	07/19/2002	S-A4-3-2	Manganese	100	J	0.28
106	07/17/2002	S-MA-6-4	Manganese	240		0.055
107	07/17/2002	S-MA-9-2	Manganese	550		0.3
108	07/17/2002	S-NA-8-2	Manganese	38		0.066
109	07/17/2002	S-NA9-2	Manganese	170		0.056
110	07/17/2002	S-NA9-2D	Manganese	230		0.12
111	07/17/2002	S-WA-8-2	Manganese	580		0.062
112	07/17/2002	S-WA-9-2	Manganese	120		0.061
113	07/19/2002	A3-20-2	Vanadium	57		0.42
114	07/19/2002	A3-23-2	Vanadium	49		0.087
115	07/18/2002	A3-25-2	Vanadium	53		0.17
116	07/18/2002	A2-7-3	Vanadium	69		0.1
117	07/18/2002	A2-15-3	Vanadium	46		0.095
118	07/18/2002	A2-23-3	Vanadium	47		0.096
119	07/18/2002	A2-24-3	Vanadium	39		0.091
120	07/18/2002	A2-19-6	Vanadium	57		0.11
121	07/16/2002	S-A1-23-7	Vanadium	29		0.092
122	07/16/2002	S-A1-24-10	Vanadium	24		0.18
123	07/15/2002	S-A1-3-9	Vanadium	28		0.082
124	07/15/2002	S-A1-6-9	Vanadium	16		0.084
125	07/15/2002	S-A1-7-3	Vanadium	39		0.18
126	07/19/2002	S-A3-19-5	Vanadium	72		0.2
127	07/19/2002	S-A3-22-6	Vanadium	47		0.084
128	07/19/2002	S-A4-15-2	Vanadium	59		0.51
129	07/19/2002	S-A4-15-20	Vanadium	66		0.54
130	07/19/2002	S-A4-1-6	Vanadium	37		0.18
131	07/19/2002	S-A4-17-2	Vanadium	50		0.45
132	07/19/2002	S-A4-22-2	Vanadium	42		0.19
133	07/19/2002	S-A4-3-2	Vanadium	48		0.43
134	07/17/2002	S-MA-6-4	Vanadium	62		0.084
135	07/17/2002	S-MA-9-2	Vanadium	51		0.46
136	07/17/2002	S-NA-8-2	Vanadium	41		0.1
137	07/17/2002	S-NA9-2	Vanadium	55		0.085
138	07/17/2002	S-NA9-2D	Vanadium	52		0.19
139	07/17/2002	S-WA-8-2	Vanadium	28		0.094
140	07/17/2002	S-WA-9-2	Vanadium	26		0.093
141	07/19/2002	A3-20-2	Zinc	1900		1.1
142	07/19/2002	A3-23-2	Zinc	1500		2.3
143	07/18/2002	A3-25-2	Zinc	1700		0.46
144	07/18/2002	A2-7-3	Zinc	620		0.27

Table C-1. Soil Analytical Data (mg/kg) Used in the Estimation of On-Site 95% Upper Confidence Limits

ID	Date	Sample	Analyte	Value	QA/QC	Reporting Limit
145	07/18/2002	A2-15-3	Zinc	1800		0.25
146	07/18/2002	A2-23-3	Zinc	2700		0.26
147	07/18/2002	A2-24-3	Zinc	2700		0.24
148	07/18/2002	A2-19-6	Zinc	2200		0.28
149	07/16/2002	S-A1-23-7	Zinc	5700		1.2
150	07/16/2002	S-A1-24-10	Zinc	2000		0.48
151	07/15/2002	S-A1-3-9	Zinc	1100		0.22
152	07/15/2002	S-A1-6-9	Zinc	11000		2.2
153	07/15/2002	S-A1-7-3	Zinc	2800		0.47
154	07/19/2002	S-A3-19-5	Zinc	2000	J	0.52
155	07/19/2002	S-A3-22-6	Zinc	3900	J	2.2
156	07/19/2002	S-A4-15-2	Zinc	190	J	1.3
157	07/19/2002	S-A4-15-20	Zinc	400	J	1.4
158	07/19/2002	S-A4-1-6	Zinc	50	J	0.49
159	07/19/2002	S-A4-17-2	Zinc	990	J	1.2
160	07/19/2002	S-A4-22-2	Zinc	420	J	0.51
161	07/19/2002	S-A4-3-2	Zinc	350	J	1.1
162	07/17/2002	S-MA-6-4	Zinc	550		0.22
163	07/17/2002	S-MA-9-2	Zinc	2500		1.2
164	07/17/2002	S-NA-8-2	Zinc	130		0.27
165	07/17/2002	S-NA9-2	Zinc	350		0.23
166	07/17/2002	S-NA9-2D	Zinc	270		0.5
167	07/17/2002	S-WA-8-2	Zinc	2200		0.25
168	07/17/2002	S-WA-9-2	Zinc	1400		0.25

Table C-2. 95% Upper Confidence Limits for Soil (mg/kg)

Analyte	CAS	# Samples	# Hits	Reporting Limit		Detected Concentrations			Mean	Distribution	UCL		
				Min	Max	Min	Max	Location			Normal	Lognormal	Neither
Arsenic	07440-38-2	28	28	3.30E-01	2.20E+00	1.90E+00	1.30E+01	S-A3-19-5, S-A4-15-20	6.75E+00	Lognormal	7.83E+00	7.93E+00	7.83E+00
Cadmium	7440-43-9	28	28	3.90E-02	2.50E-01	1.20E-01	8.70E+01	S-A1-6-9	1.53E+01	Lognormal	2.26E+01	3.19E+01	2.26E+01
Iron	7439-89-6	28	28	3.20E+00	3.80E+01	9.10E+03	4.70E+04	S-WA-8-2	2.22E+04	Lognormal	2.49E+04	2.50E+04	2.49E+04
Manganese	7439-96-5	28	28	5.40E-02	3.60E-01	3.80E+01	1.90E+03	S-A4-15-2	3.79E+02	Lognormal	5.09E+02	5.06E+02	5.09E+02
Vanadium	7440-62-2	28	28	8.20E-02	5.40E-01	1.60E+01	7.20E+01	S-A3-19-5	4.60E+01	Normal	5.06E+01	5.09E+01	5.06E+01
Zinc	7440-66-6	28	28	2.20E-01	2.30E+00	5.00E+01	1.10E+04	S-A1-6-9	1.91E+03	Lognormal	2.62E+03	3.01E+03	2.62E+03

Table C-3. Groundwater Analytical Data Used in the Estimation of On-Site 95% Upper Confidence Limits (ug/L)

ID	Date	Sample	S/D	Analyte	Value	QA/QC	Reporting Limit
1	03/18/2003	G101-030318		Aluminum	1600		29
2	03/18/2003	G101-030318		Arsenic	8.1	U	8.1
3	03/18/2003	G101-030318		Cadmium	0.53	U	0.53
4	03/18/2003	G101-030318		Cadmium - Dissolved	0.53	U	0.53
5	03/18/2003	G101-030318		Chromium	3.5		0.93
6	03/18/2003	G101-030318		Iron	2100	J	19
7	03/18/2003	G101-030318		Lead	1.3	U	1.3
8	03/18/2003	G101-030318		Lead - Dissolved	1.3	U	1.3
9	03/18/2003	G101-030318		Manganese	55		0.32
10	03/18/2003	G101-030318		Manganese - Dissolved	1.4	J	0.32
11	03/18/2003	G101-030318		Thallium	4.3	U	4.3
12	03/18/2003	G101-030318		Thallium - Dissolved	4.3	U	4.3
13	03/18/2003	G101-030318		Vanadium	3.6	J	0.84
14	03/18/2003	G101-030318		Zinc	82		2.5
15	03/18/2003	G101-030318		Zinc - Dissolved	26		2.5
16	03/18/2003	G102-030318		Aluminum	82	J	27
17	03/18/2003	G102-030318		Arsenic	8.1	U	8.1
18	03/18/2003	G102-030318		Cadmium	0.53	U	0.53
19	03/18/2003	G102-030318		Cadmium - Dissolved	0.53	U	0.53
20	03/18/2003	G102-030318		Chromium	0.93	U	0.93
21	03/18/2003	G102-030318		Iron	300	J	19
22	03/18/2003	G102-030318		Lead	1.3	U	1.3
23	03/18/2003	G102-030318		Lead - Dissolved	1.3	U	1.3
24	03/18/2003	G102-030318		Manganese	290		0.32
25	03/18/2003	G102-030318		Manganese - Dissolved	290	J	0.32
26	03/18/2003	G102-030318		Thallium	4.3	U	4.3
27	03/18/2003	G102-030318		Thallium - Dissolved	4.3	U	4.3
28	03/18/2003	G102-030318		Vanadium	0.84	U	0.84
29	03/18/2003	G102-030318		Zinc	3.5	J	2.5
30	03/18/2003	G102-030318		Zinc - Dissolved	5.3	J	2.5
31	03/19/2003	G103-030319		Aluminum	170	J	27
32	03/19/2003	G103-030319		Arsenic	8.1	U	8.1
33	03/19/2003	G103-030319		Cadmium	0.53	U	0.53
34	03/19/2003	G103-030319		Cadmium - Dissolved	0.53	U	0.53
35	03/19/2003	G103-030319		Chromium	0.93	U	0.93
36	03/19/2003	G103-030319		Iron	280	J	19
37	03/19/2003	G103-030319		Lead	1.3	U	1.3
38	03/19/2003	G103-030319		Lead - Dissolved	1.3	U	1.3
39	03/19/2003	G103-030319		Manganese	16		0.32
40	03/19/2003	G103-030319		Manganese - Dissolved	12	J	0.32
41	03/19/2003	G103-030319		Thallium	4.3	U	4.3
42	03/19/2003	G103-030319		Thallium - Dissolved	4.3	U	4.3
43	03/19/2003	G103-030319		Vanadium	0.84	U	0.84
44	03/19/2003	G103-030319		Zinc	11	J	2.5
45	03/19/2003	G103-030319		Zinc - Dissolved	9	J	2.5
46	03/18/2003	G104-030318		Aluminum	53000		27
47	03/18/2003	G104-030318		Arsenic	45		8.1
48	03/18/2003	G104-030318		Cadmium	0.53	U	0.53

Table C-3. Groundwater Analytical Data Used in the Estimation of On-Site 95% Upper Confidence Limits (ug/L)

ID	Date	Sample	S/D	Analyte	Value	QA/QC	Reporting Limit
49	03/18/2003	G104-030318		Cadmium - Dissolved	0.53	U	0.53
50	03/18/2003	G104-030318		Chromium	79		0.93
51	03/18/2003	G104-030318		Iron	110000	J	19
52	03/18/2003	G104-030318		Lead	79	J	1.3
53	03/18/2003	G104-030318		Lead - Dissolved	1.3	U	1.3
54	03/18/2003	G104-030318		Manganese	2200		0.32
55	03/18/2003	G104-030318		Manganese - Dissolved	18	J	0.32
56	03/18/2003	G104-030318		Thallium	4.3	U	4.3
57	03/18/2003	G104-030318		Thallium - Dissolved	4.3	U	4.3
58	03/18/2003	G104-030318		Vanadium	110		0.84
59	03/18/2003	G104-030318		Zinc	1500		2.5
60	03/18/2003	G104-030318		Zinc - Dissolved	110		2.5
61	03/18/2003	G105-030318		Aluminum	540		27
62	03/18/2003	G105-030318		Arsenic	8.1	U	8.1
63	03/18/2003	G105-030318		Cadmium	0.53	U	0.53
64	03/18/2003	G105-030318		Cadmium - Dissolved	0.53	U	0.53
65	03/18/2003	G105-030318		Chromium	0.93	U	0.93
66	03/18/2003	G105-030318		Iron	810	J	19
67	03/18/2003	G105-030318		Lead	1.3	U	1.3
68	03/18/2003	G105-030318		Lead - Dissolved	1.3	U	1.3
69	03/18/2003	G105-030318		Manganese	86		0.32
70	03/18/2003	G105-030318		Manganese - Dissolved	86	J	0.32
71	03/18/2003	G105-030318		Thallium	4.3	U	4.3
72	03/18/2003	G105-030318		Thallium - Dissolved	4.3	U	4.3
73	03/18/2003	G105-030318		Vanadium	1.8	J	0.84
74	03/18/2003	G105-030318		Zinc	12	J	2.5
75	03/18/2003	G105-030318		Zinc - Dissolved	8.7	J	2.5
76	03/19/2003	G106-030319		Aluminum	340		27
77	03/19/2003	G106-030319		Arsenic	8.1	U	8.1
78	03/19/2003	G106-030319		Cadmium	0.53	U	0.53
79	03/19/2003	G106-030319		Cadmium - Dissolved	0.53	U	0.53
80	03/19/2003	G106-030319		Chromium	0.93	U	0.93
81	03/19/2003	G106-030319		Iron	480	J	19
82	03/19/2003	G106-030319		Lead	1.3	U	1.3
83	03/19/2003	G106-030319		Lead - Dissolved	1.3	U	1.3
84	03/19/2003	G106-030319		Manganese	20		0.32
85	03/19/2003	G106-030319		Manganese - Dissolved	2.5	J	0.32
86	03/19/2003	G106-030319		Thallium	4.3	U	4.3
87	03/19/2003	G106-030319		Thallium - Dissolved	4.3	U	4.3
88	03/19/2003	G106-030319		Vanadium	0.86	J	0.84
89	03/19/2003	G106-030319		Zinc	70		5
90	03/19/2003	G106-030319		Zinc - Dissolved	26		2.5
91	03/19/2003	G107-030319		Aluminum	610		27
92	03/19/2003	G107-030319		Arsenic	8.1	U	8.1
93	03/19/2003	G107-030319		Cadmium	61	J	0.53
94	03/19/2003	G107-030319		Cadmium - Dissolved	35		0.53
95	03/19/2003	G107-030319		Chromium	1.5	J	0.93
96	03/19/2003	G107-030319		Iron	11000	J	19

Table C-3. Groundwater Analytical Data Used in the Estimation of On-Site 95% Upper Confidence Limits (ug/L)

ID	Date	Sample	S/D	Analyte	Value	QA/QC	Reporting Limit
97	03/19/2003	G107-030319		Lead	61	J	1.3
98	03/19/2003	G107-030319		Lead - Dissolved	6.8	J	1.3
99	03/19/2003	G107-030319		Manganese	1100		0.32
100	03/19/2003	G107-030319		Manganese - Dissolved	1200	J	0.32
101	03/19/2003	G107-030319		Thallium	4.3	U	4.3
102	03/19/2003	G107-030319		Thallium - Dissolved	4.3	U	4.3
103	03/19/2003	G107-030319		Vanadium	1.1	J	0.84
104	03/19/2003	G107-030319		Zinc	19000		25
105	03/19/2003	G107-030319		Zinc - Dissolved	17000		2.5
106	03/18/2003	G109-030318		Aluminum	110000		27
107	03/18/2003	G109-030318		Arsenic	75		8.1
108	03/18/2003	G109-030318		Cadmium	0.53	U	0.53
109	03/18/2003	G109-030318		Cadmium - Dissolved	0.53	U	0.53
110	03/18/2003	G109-030318		Chromium	170		0.93
111	03/18/2003	G109-030318		Iron	210000	J	19
112	03/18/2003	G109-030318		Lead	150	J	1.3
113	03/18/2003	G109-030318		Lead - Dissolved	1.3	U	1.3
114	03/18/2003	G109-030318		Manganese	8100		0.32
115	03/18/2003	G109-030318		Manganese - Dissolved	16	J	0.32
116	03/18/2003	G109-030318		Thallium	4.3	U	4.3
117	03/18/2003	G109-030318		Thallium - Dissolved	4.3	U	4.3
118	03/18/2003	G109-030318		Vanadium	200		0.84
119	03/18/2003	G109-030318		Zinc	920		5
120	03/18/2003	G109-030318		Zinc - Dissolved	5	J	2.5
121	03/18/2003	MW10-303018		Aluminum	69000		27
122	03/18/2003	MW10-303018		Arsenic	58		8.1
123	03/18/2003	MW10-303018		Cadmium	0.53	U	0.53
124	03/18/2003	MW10-303018		Cadmium - Dissolved	0.53	U	0.53
125	03/18/2003	MW10-303018		Chromium	160		0.93
126	03/18/2003	MW10-303018		Iron	130000	J	19
127	03/18/2003	MW10-303018		Lead	80	J	1.3
128	03/18/2003	MW10-303018		Lead - Dissolved	1.3	U	1.3
129	03/18/2003	MW10-303018		Manganese	2800		0.32
130	03/18/2003	MW10-303018		Manganese - Dissolved	14	J	0.32
131	03/18/2003	MW10-303018		Thallium	4.3	U	4.3
132	03/18/2003	MW10-303018		Thallium - Dissolved	4.3	U	4.3
133	03/18/2003	MW10-303018		Vanadium	190		0.84
134	03/18/2003	MW10-303018		Zinc	590		5
135	03/18/2003	MW10-303018		Zinc - Dissolved	11	J	2.5
136	03/19/2003	MW1-030319	1	Aluminum	1500		27
137	03/19/2003	MW1-030319	1	Arsenic	8.1	U	8.1
138	03/19/2003	MW1-030319	1	Cadmium	0.53	U	0.53
139	03/19/2003	MW1-030319	1	Cadmium - Dissolved	0.53	U	0.53
140	03/19/2003	MW1-030319	1	Chromium	0.93	U	0.93
141	03/19/2003	MW1-030319	1	Iron	1700	J	19
142	03/19/2003	MW1-030319	1	Lead	1.3	U	1.3
143	03/19/2003	MW1-030319	1	Lead - Dissolved	1.3	U	1.3
144	03/19/2003	MW1-030319	1	Manganese	72		0.32

Table C-3. Groundwater Analytical Data Used in the Estimation of On-Site 95% Upper Confidence Limits (ug/L)

ID	Date	Sample	S/D	Analyte	Value	QA/QC	Reporting Limit
145	03/19/2003	MW1-030319	1	Manganese - Dissolved	19	J	0.32
146	03/19/2003	MW1-030319	1	Thallium	4.3	J	4.3
147	03/19/2003	MW1-030319	1	Thallium - Dissolved	4.3	U	4.3
148	03/19/2003	MW1-030319	1	Vanadium	2.3	J	0.84
149	03/19/2003	MW1-030319	1	Zinc	940		2.5
150	03/19/2003	MW1-030319	1	Zinc - Dissolved	970		2.5
151	03/19/2003	MW1-030319	1	Aluminum	1600		27
152	03/19/2003	MW1-030319	1	Arsenic	8.1	U	8.1
153	03/19/2003	MW1-030319	1	Cadmium	0.53	U	0.53
154	03/19/2003	MW1-030319	1	Cadmium - Dissolved	0.53	U	0.53
155	03/19/2003	MW1-030319	1	Chromium	0.93	U	0.93
156	03/19/2003	MW1-030319	1	Iron	2100	J	19
157	03/19/2003	MW1-030319	1	Lead	1.3	U	1.3
158	03/19/2003	MW1-030319	1	Lead - Dissolved	1.3	U	1.3
159	03/19/2003	MW1-030319	1	Manganese	78		0.32
160	03/19/2003	MW1-030319	1	Manganese - Dissolved	17	J	0.32
161	03/19/2003	MW1-030319	1	Thallium	4.3	U	4.3
162	03/19/2003	MW1-030319	1	Thallium - Dissolved	4.3	U	4.3
163	03/19/2003	MW1-030319	1	Vanadium	2.9	J	0.84
164	03/19/2003	MW1-030319	1	Zinc	990		5
165	03/19/2003	MW1-030319	1	Zinc - Dissolved	1100		2.5
166	03/18/2003	MW2-030318		Aluminum	670		27
167	03/18/2003	MW2-030318		Arsenic	8.1	U	8.1
168	03/18/2003	MW2-030318		Cadmium	5.3	J	0.53
169	03/18/2003	MW2-030318		Cadmium - Dissolved	5.4		0.53
170	03/18/2003	MW2-030318		Chromium	0.93	U	0.93
171	03/18/2003	MW2-030318		Iron	1100	J	19
172	03/18/2003	MW2-030318		Lead	1.3	U	1.3
173	03/18/2003	MW2-030318		Lead - Dissolved	1.3	U	1.3
174	03/18/2003	MW2-030318		Manganese	53		0.32
175	03/18/2003	MW2-030318		Manganese - Dissolved	56	J	0.32
176	03/18/2003	MW2-030318		Thallium	4.3	U	4.3
177	03/18/2003	MW2-030318		Thallium - Dissolved	4.3	U	4.3
178	03/18/2003	MW2-030318		Vanadium	1.4	J	0.84
179	03/18/2003	MW2-030318		Zinc	4100		5
180	03/18/2003	MW2-030318		Zinc - Dissolved	4500		2.5
181	03/18/2003	MW3-030318		Aluminum	27	U	27
182	03/18/2003	MW3-030318		Arsenic	8.1	U	8.1
183	03/18/2003	MW3-030318		Cadmium	0.53	U	0.53
184	03/18/2003	MW3-030318		Cadmium - Dissolved	0.53	U	0.53
185	03/18/2003	MW3-030318		Chromium	0.93	U	0.93
186	03/18/2003	MW3-030318		Iron	40	J	19
187	03/18/2003	MW3-030318		Lead	1.3	U	1.3
188	03/18/2003	MW3-030318		Lead - Dissolved	1.3	U	1.3
189	03/18/2003	MW3-030318		Manganese	61		0.32
190	03/18/2003	MW3-030318		Manganese - Dissolved	58	J	0.32
191	03/18/2003	MW3-030318		Thallium	4.3	U	4.3
192	03/18/2003	MW3-030318		Thallium - Dissolved	4.3	U	4.3

Table C-3. Groundwater Analytical Data Used in the Estimation of On-Site 95% Upper Confidence Limits (ug/L)

ID	Date	Sample	S/D	Analyte	Value	QA/QC	Reporting Limit
193	03/18/2003	MW3-030318		Vanadium	0.84	U	0.84
194	03/18/2003	MW3-030318		Zinc	860		5
195	03/18/2003	MW3-030318		Zinc - Dissolved	890		2.5
196	03/18/2003	MW4-030318		Aluminum	37000		27
197	03/18/2003	MW4-030318		Arsenic	17		8.1
198	03/18/2003	MW4-030318		Cadmium	82	J	0.53
199	03/18/2003	MW4-030318		Cadmium - Dissolved	0.71	J	0.53
200	03/18/2003	MW4-030318		Chromium	90		0.93
201	03/18/2003	MW4-030318		Iron	49000	J	19
202	03/18/2003	MW4-030318		Lead	930	J	1.3
203	03/18/2003	MW4-030318		Lead - Dissolved	1.5	J	1.3
204	03/18/2003	MW4-030318		Manganese	1400		0.32
205	03/18/2003	MW4-030318		Manganese - Dissolved	780	J	0.32
206	03/18/2003	MW4-030318		Thallium	4.3	U	4.3
207	03/18/2003	MW4-030318		Thallium - Dissolved	4.3	U	4.3
208	03/18/2003	MW4-030318		Vanadium	96		0.84
209	03/18/2003	MW4-030318		Zinc	210000		120
210	03/18/2003	MW4-030318		Zinc - Dissolved	2300		2.5
211	03/18/2003	MW5-030318		Aluminum	1200		27
212	03/18/2003	MW5-030318		Arsenic	8.1	U	8.1
213	03/18/2003	MW5-030318		Cadmium	0.53	U	0.53
214	03/18/2003	MW5-030318		Cadmium - Dissolved	0.53	U	0.53
215	03/18/2003	MW5-030318		Chromium	1.6	J	0.93
216	03/18/2003	MW5-030318		Iron	1100	J	19
217	03/18/2003	MW5-030318		Lead	1.3	U	1.3
218	03/18/2003	MW5-030318		Lead - Dissolved	1.3	U	1.3
219	03/18/2003	MW5-030318		Manganese	150		0.32
220	03/18/2003	MW5-030318		Manganese - Dissolved	170	J	0.32
221	03/18/2003	MW5-030318		Thallium	4.3	U	4.3
222	03/18/2003	MW5-030318		Thallium - Dissolved	4.3	U	4.3
223	03/18/2003	MW5-030318		Vanadium	2.9	J	0.84
224	03/18/2003	MW5-030318		Zinc	300		5
225	03/18/2003	MW5-030318		Zinc - Dissolved	310		2.5
226	03/18/2003	MW6-030318		Aluminum	300		27
227	03/18/2003	MW6-030318		Arsenic	8.1	U	8.1
228	03/18/2003	MW6-030318		Cadmium	86	J	0.53
229	03/18/2003	MW6-030318		Cadmium - Dissolved	79		0.53
230	03/18/2003	MW6-030318		Chromium	0.93	U	0.93
231	03/18/2003	MW6-030318		Iron	570	J	19
232	03/18/2003	MW6-030318		Lead	9.6	J	1.3
233	03/18/2003	MW6-030318		Lead - Dissolved	1.3	U	1.3
234	03/18/2003	MW6-030318		Manganese	870		0.32
235	03/18/2003	MW6-030318		Manganese - Dissolved	940	J	0.32
236	03/18/2003	MW6-030318		Thallium	4.3	U	4.3
237	03/18/2003	MW6-030318		Thallium - Dissolved	4.3	U	4.3
238	03/18/2003	MW6-030318		Vanadium	0.84	U	0.84
239	03/18/2003	MW6-030318		Zinc	7100		25
240	03/18/2003	MW6-030318		Zinc - Dissolved	6400		2.5

Table C-3. Groundwater Analytical Data Used in the Estimation of On-Site 95% Upper Confidence Limits (ug/L)

ID	Date	Sample	S/D	Analyte	Value	QA/QC	Reporting Limit
241	03/18/2003	MW7-030318		Aluminum	27	U	27
242	03/18/2003	MW7-030318		Arsenic	8.1	U	8.1
243	03/18/2003	MW7-030318		Cadmium	390	J	0.53
244	03/18/2003	MW7-030318		Cadmium - Dissolved	330		0.53
245	03/18/2003	MW7-030318		Chromium	1.2	J	0.93
246	03/18/2003	MW7-030318		Iron	50	J	19
247	03/18/2003	MW7-030318		Lead	1.3	U	1.3
248	03/18/2003	MW7-030318		Lead - Dissolved	1.3	U	1.3
249	03/18/2003	MW7-030318		Manganese	12000		0.32
250	03/18/2003	MW7-030318		Manganese - Dissolved	13000	J	0.32
251	03/18/2003	MW7-030318		Thallium	4.3	U	4.3
252	03/18/2003	MW7-030318		Thallium - Dissolved	7.4	J	4.3
253	03/18/2003	MW7-030318		Vanadium	0.84	U	0.84
254	03/18/2003	MW7-030318		Zinc	120000		25
255	03/18/2003	MW7-030318		Zinc - Dissolved	120000		25
256	03/19/2003	MW8-030319		Aluminum	190	J	27
257	03/19/2003	MW8-030319		Arsenic	8.1	U	8.1
258	03/19/2003	MW8-030319		Cadmium	31	J	0.53
259	03/19/2003	MW8-030319		Cadmium - Dissolved	25		0.53
260	03/19/2003	MW8-030319		Chromium	0.93	U	0.93
261	03/19/2003	MW8-030319		Iron	1500	J	19
262	03/19/2003	MW8-030319		Lead	130	J	1.3
263	03/19/2003	MW8-030319		Lead - Dissolved	18		1.3
264	03/19/2003	MW8-030319		Manganese	4.4		0.32
265	03/19/2003	MW8-030319		Manganese - Dissolved	3.2	J	0.32
266	03/19/2003	MW8-030319		Thallium	4.3	U	4.3
267	03/19/2003	MW8-030319		Thallium - Dissolved	4.3	U	4.3
268	03/19/2003	MW8-030319		Vanadium	1	J	0.84
269	03/19/2003	MW8-030319		Zinc	13000		25
270	03/19/2003	MW8-030319		Zinc - Dissolved	13000		2.5
271	03/19/2003	MW9-030319		Aluminum	33	J	27
272	03/19/2003	MW9-030319		Arsenic	8.1	U	8.1
273	03/19/2003	MW9-030319		Cadmium	0.73	J	0.53
274	03/19/2003	MW9-030319		Cadmium - Dissolved	0.91	J	0.53
275	03/19/2003	MW9-030319		Chromium	0.93	U	0.93
276	03/19/2003	MW9-030319		Iron	190	J	19
277	03/19/2003	MW9-030319		Lead	3.4	J	1.3
278	03/19/2003	MW9-030319		Lead - Dissolved	1.3	U	1.3
279	03/19/2003	MW9-030319		Manganese	920		0.32
280	03/19/2003	MW9-030319		Manganese - Dissolved	1000	J	0.32
281	03/19/2003	MW9-030319		Thallium	4.3	U	4.3
282	03/19/2003	MW9-030319		Thallium - Dissolved	4.3	U	4.3
283	03/19/2003	MW9-030319		Vanadium	0.92	J	0.84
284	03/19/2003	MW9-030319		Zinc	240		5
285	03/19/2003	MW9-030319		Zinc - Dissolved	200		2.5